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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WARTIME REPORT

ORIGINALLY ISSUED
March 1945 as
Memorandum Report L5C24a

LIFT TESTS OF A 0.1536c THICK DOUGLAS AIRFOIL SECTION OF NACA 7-SERIES TYPE EQUIPPED WITH A LATERAL-CONTROL DEVICE FOR USE WITH A FULL-SPAN DOUBLE-SLOTTED FLAP ON THE C-74 AIRPLANE

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NACA

WASHINGTON

MR No. L5C24a

NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

MEMORANDUM REPORT

for the

Army Air Forces, Air Technical Service Command

LIFT TESTS OF A 0.1536c THICK DOUGLAS AIRFOIL SECTION OF NACA 7-SERIES TYPE EQUIPPED WITH A LATERAL-CONTROL DEVICE FOR USE WITH A FULL-SPAN DOUBLE-SLOTTED FLAP ON THE C-74 AIRPLANE

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INTRODUCTION

A recent trend in the design of long-range airplanes has been toward the use of high wing loadings and large aspect ratios. As a result of this trend, full-span flaps are often required for satisfactory take-off and landing characteristics, and the problem of obtaining adequate lateral control in conjunction with a full-span flap has presented itself.

At the request of the Army Air Forces, Air Technical Service Command, lift tests of a two-dimensional airfoil model equipped with a double-slotted flap and lateral-control device were made in the Langley two-dimensional low-turbulence pressure tunnel. The model represented the master outboard wing section (station 950) of the proposed Douglas C-74 airplane. The tests were made for the most part at a Reynolds number of approximately 6,000,000, primarily for the purpose of determining the flap settings which would give adequate maximum lift and lateral control characteristics for both the take-off and landing conditions. Several additional tests were made to determine the effect of Reynolds number, roughness, and sealed gaps on the lift characteristics.

COEFFICIENTS AND SYMBOLS

The coefficients and symbols used herein are defined as follows:

c_l	section lift coefficient
α_o	section angle of attack measured from the model reference line (degrees)
δ_f	flap deflection (degrees)
δ_R	aileron deflection (degrees)
δ_L	flip deflection (degrees)
$\Delta\alpha_o$	increment of section angle of attack (degrees)
c	model chord (inches)
R	Reynolds number

MODEL

The model, submitted by the Douglas Aircraft Company, represented the master outboard wing section (station 950) of the proposed C-74 airplane and was a 24-inch-chord, two-dimensional Douglas wing section having the contour of an NACA 7-series type airfoil. Ordinates for the plain airfoil, given in percent of the chord and measured with respect to the wing reference line, are presented in table I. Photographs of the model are shown in figure 1. The general outline of the model, which had a maximum thickness of 0.1536c and which was equipped with a double-slotted flap, contour Frise aileron (aileron), and slot-lip aileron (flip), is shown in figure 2.

Figure 3 shows the arrangement of the control surfaces in their neutral positions, flap retracted and deflected 50°. Also included in figure 3 are the dimensions of the control surfaces and the location of their hinge lines. The double-slotted flap consisted of two parts. The forward portion of the flap, designated as a vane, was separated from the main part, designated

the rear flap, by a secondary slot. The double-slotted flap, which operated as a unit with no relative motion between the vane and the rear flap, rotated about a fixed hinge line located below the model. The aft portion of the rear flap, which was separated from the forward portion of the rear flap by a tertiary slot, was used as an aileron and rotated with respect to the flap. A rear portion of the upper surface of the model was used as a flip which was movable about a hinge line fixed in the model.

TESTS

Most of the included data were obtained at a Reynolds number of approximately 6,000,000 using the test methods described in reference 1, primarly for the purpose of approximating the flight Reynolds number for the landing condition which is estimated to be about 5,400,000. These data have been corrected for tunnel-wall constriction by the following formula:

$$c_l = 0.975\ c_l'$$

where the primed quantity represents the value of the lift coefficient measured in the tunnel. Some lift characteristics were obtained at Reynolds numbers of approximately 3,000,000 and 9,000,000 which correspond to dynamic pressures of approximately 26 and 96 pounds per square foot and Mach numbers of approximately 0.060 and 0.100, respectively. The pressure of the air in the tunnel was varied between absolute pressures of approximately 30 and 95 pounds per square inch. Standard roughness was applied to the leading edge of the model by the methods described in reference 1. In addition, a test was made with transition fixed on the upper surface of the model. This was done by applying a 3-inch-wide roughness strip, located just forward of the flip, over the whole span of the model. Another test was conducted with roughness on the entire lower surface of the flip. The sealed conditions were simulated by inserting modeling clay in the gaps. An outline of the test program is given in table II.

Because of the large number of tests involved in determining the characteristics of the lateral-control

surfaces at any particular flap setting, a preliminary survey was made to facilitate the choice of flap settings (primarily for landing) for which more complete tests would be made. For this preliminary survey, with the lateral-control surfaces neutral, the lift characteristics were obtained at flap deflections of 0°, 10°, 20°, 30°, 40°, 50°, 52.5°, and 55°. Additional tests were made to determine the effectiveness of the aileron and flip at the selected flap deflections and to study the causes of the flap stall.

RESULTS AND DISCUSSION

Maximum Lift Coefficient

Variation with flap deflection.- In order to be certain that satisfactory maximum lift coefficients were obtainable with the present arrangement of the control surfaces and the flap, a series of tests were made with the flap retracted and deflected in small increments to a maximum of 55° (control surfaces neutral). The results of these tests, presented in figure 4, appear to be normal for flap deflections through 40° and indicate that the maximum section lift coefficient increases from 1.62 with the flap retracted to 3.13 with the flap deflected 52.5°. With the flap deflected 50° the flow is unstalled only for section angles of attack less than -16° although at this flap deflection the maximum section lift coefficient was 3.07 as compared with 2.85 for the flap in the 40° position. Because of the small changes in section lift coefficient for flap deflections of 52.5° and 55°, the flow appears to be partially stalled throughout the entire range of angles of attack investigated for these flap settings. With the flap deflected 55°, a hysteresis effect in the lift curve is observed between angles of attack of 0° and 14°. Although a maximum section lift coefficient of 3.13 was obtained for the 52.5° flap deflection, subsequent tests were limited to maximum flap deflection of 50° in order to be sure of avoiding the dangerous hysteresis characteristics occurring with the flap deflected 55°.

Effect of sealing various gaps.- The results of the tests with the aileron gap sealed (not faired) and with all the gaps open are presented in figures 5, 6, 7, and 8 for flap settings of 0°, 25°, 45°, and 50°, respectively,

with the flip neutral and with the aileron deflected. Figure 9 presents the results of the tests with various gaps sealed for the configuration with the flap retracted and with the control surfaces neutral. Values of the maximum section lift coefficient obtained at several flap deflections, gaps sealed and unsealed, are tabulated below for the condition with the control surfaces neutral.

Configuration	Maximum section lift coefficient			
	Flap deflection, δ_f			
	0°	25°	45°	50°
All gaps open	1.62	2.37	2.90	3.07
Aileron gap sealed	1.53	2.13	2.90	3.15
Flip gap sealed	1.63	----	----	----
Gap A and flip gap sealed	1.64	----	----	----
Gap A faired, aileron gap sealed	1.54	----	----	----
All gaps faired	1.54	----	----	----

Sealing the aileron gap reduced the maximum section lift coefficient with the flap retracted regardless of the condition of the other gaps. Sealing the aileron gap resulted in an increase in the maximum section lift coefficient with the flap deflected 50°.

Aileron and Flip Effectiveness

The lift characteristics obtained in determining the aileron and flip effectiveness at the four previously tested flap settings of 0°, 25°, 45°, and 50° are shown in figures 5 to 8 and 10 to 15. Data from these figures are presented in figures 16, 17, 18, and 19 as the variation of the increment of section angle of attack $\Delta\alpha_o$ with aileron deflection, for various deflections of the flip, at a lift coefficient which was constant for each flap setting. It is observed in figures 16 and 17, with the flip neutral and with the flap deflected 0° and 25°, respectively, that sealing the aileron gap had no appreciable effect on the variation of $\Delta\alpha_o$ with aileron deflection. At flap deflections of 45° and 50°, however, with the flip neutral (figs. 18 and 19), sealing the aileron gap resulted in a reversal of $\Delta\alpha_o$ for all

positive aileron deflections investigated. Figure 18 shows that for the flip-neutral condition ($\delta_f = 45^\circ$), the aileron is ineffective for small deflections. Between aileron deflections of about -2° to -7°, with the flip neutral, the increment of section angle of attack increases rapidly and is about the same for both conditions of the aileron gap. For aileron deflections more negative than about -7°, however, $\Delta\alpha_o$ is greater when all gaps are open. For all negative aileron settings investigated with the flap extended 50° and with the flip neutral, the increment of section angle of attack is larger when the aileron gap is sealed (fig. 19).

It is observed in figures 17, 18, and 19, (all gaps open) that for all aileron deflections investigated a sudden increase of $\Delta\alpha_o$ with flip deflection results at progressively smaller negative flip deflections as the flap is deflected. The sudden increase of $\Delta\alpha_o$ is attributed to the separation of the air flow over the flap, this separation being more readily induced at flap deflections above 40°. (See fig. 4.)

A comparison of the flip effectiveness for various flap deflections with the aileron neutral is shown in figure 20. Since the complete range of flip deflections was not covered in the tests with the aileron neutral and with the flap deflected, some of the values of $\Delta\alpha_o$, shown in figure 20, were obtained by extending the curves shown in figure 17, 18, and 19. It is seen from figure 20 that, in general, the flip effectiveness increases with flap deflection. This substantially agrees with the data of references 2 and 3. A comparison of figures 17 and 20 shows that for a flap deflection of 25° the flip is about equally as effective as the aileron. Above flap deflections of 25°, however, the flip becomes considerably more effective than the aileron.

It is noted in figure 15(b) that there is a serious break in the lift curve at a section angle of attack of 0° for the configuration with the flap, aileron, and flip deflected 50°, 0°, and -5°, respectively. Further increases in the flip deflection to -7° and -10° resulted in a complete breakdown of the air flow over the flap throughout the entire range of angles of attack investigated. No evidence of the above discontinuities is indicated from the results of figures 12 and 21 for a similar configuration of the control surfaces with the

flap deflected 45°, although it is apparent from the results of figure 12 that a gradual change in air flow over the flap occurs between flip deflections of -6° and -8° with the aileron deflected -5°. With the present arrangement of the control surfaces, therefore, the 45° flap deflection is approximately the largest flap deflection that gives lateral control characteristics free from the anomalous behavior shown in figure 15(b).

Study of Flap Stall

In an attempt to study the causes of the sharp break in the lift curve first noticed with the flap, aileron, and flip deflected 50°, 0°, and -5°, respectively, and to determine the range of configurations over which the aforementioned break in the lift curves might exist, the following tests were made:

(1) Aileron gap sealed, not faired (fig. 22)

(2) Roughness applied to the bottom of the flip and then to the upper surface of the airfoil just forward of the flip (fig. 23)

(3) Flip gap sealed, faired, and not faired (fig. 24)

(4) Reynolds number varied (fig. 24)

(5) Roughness applied to the leading edge of the model (fig. 25)

Sealing the aileron gap or applying roughness to the entire lower surface of the flip and then applying a 3-inch roughness strip to the upper surface of the airfoil just forward of the flip had little effect in changing the extent of the break in the lift curve (figs. 22 and 23). Sealing the flip gap reduced the extent of the break although the resulting hysteresis effects remain objectionable. Little scale effect is noted between Reynolds numbers of 6,000,000 and 9,000,000 (fig. 24). Decreasing the Reynolds number to 3,000,000 entirely eliminated the irregularity in the lift curve; however, accompanying the decrease in Reynolds number was a large loss in section lift coefficient over the complete range of angles of attack investigated. Due to this phenomenon it is thought that if future investigations of control surfaces, similar to that considered in the present

report, are made at low Reynolds numbers, the results of these investigations should be checked at flight Reynolds numbers before application to an aircraft.

A comparison of the lift characteristics obtained with the leading edge of the model in the smooth and rough condition is presented in figure 25 for the configurations with the aileron neutral and with the flap and flip deflections varied. The results show that when standard roughness was applied, the maximum section lift coefficient was reduced about 0.4 for all flap deflections investigated. With the model in the rough condition and with the flap, aileron, and flip deflected 50°, 0°, and -5°, respectively, a gradual change in the lift curve occurs over a large range of angles of attack as opposed to the anomalous behavior with the model in the smooth condition.

Inasmuch as the landing Reynolds number of this section of the C-74 wing will be within the range of Reynolds number in which the severe air-flow breakdown occurs, the 50° flap setting is not considered satisfactory for the landing condition.

SUMMARY OF RESULTS

Tests of a Douglas airfoil section of NACA 7-series type equipped with a lateral-control device for use with a full-span double-slotted flap, indicated the following:

1. The control-surface arrangement tested may prove satisfactory for lateral control provided all gaps are unsealed and a flap deflection of 45° is not exceeded.

2. With the control surfaces neutral, a reduction in the maximum section lift coefficient was obtained whenever the aileron gap was sealed regardless of the condition of the other gaps.

3. The flip is considerably more effective than the aileron for flap deflections above about 25°.

4. The limited amount of data obtained at a low Reynolds number indicated that the scale effects at

Reynolds numbers between 3,000,000 and 6,000,000 may be serious and should be considered in the development of similar lateral-control devices.

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REFERENCES

1. Abbott, Ira H., von Doenhoff, Albert E., and Stivers, Louis S., Jr.: Summary of Airfoil Data. NACA ACR No. L5C05, 1945.

2. Rogallo, Francis M., and Spano, Bartholomew S.: Wind-Tunnel Investigation of a Plain and a Slot-Lip Aileron on a Wing with a Full-Span Slotted Flap. NACA ACR, April 1941.

3. Wetmore, Joseph W., and Sawyer, Richard H.: Flight Tests of F2A-2 Airplane with Full-Span Slotted Flaps and Trailing-Edge and Slot-Lip Ailerons. NACA ARR No. 3L07, 1943.

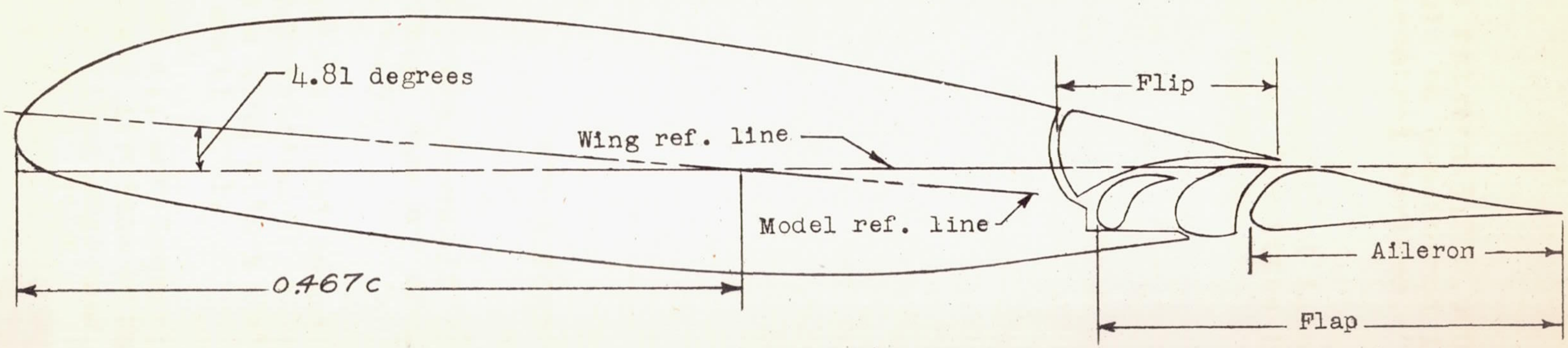

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Figure 2.- Profile view of a 24-inch chord Douglas airfoil of NACA 7-series type; station 950 of C-74 wing.

TABLE II

TEST PROGRAM

$\delta_f = 0°$

δ_R	δ_L = 0
-20	x
-15	a, x
-10	a, x
0	a, c, g, h, x, i, j
10	a, x
15	a, x
20	x

$\delta_f = 25°$

δ_R	δ_L = 2	0	-3	-5	-7	-10	-15	-20
-15		a				x	x	x
-10		a				x	x	x
-5				x		x	x	
0	x	a, x	x	x	x	x		
5	x	x		x				
10	x	a, x						
15	x	a, x						

δ_R, δ_L	δ_f = 10	20	30	40	52.5	55
0	x	x	j, x	x	x	x

$R \times 10^6$	$\delta_f = \delta_R = \delta_L = 0$
10	x
15	x

$R \times 10^6$	$\delta_f = 50°$; $\delta_R = 0°$; $\delta_L = -5°$
3	x
9	x

$\delta_f = 45°$

δ_R	δ_L = 0	-5	-6	-8	-10	-15	-20
-15	a					x	x
-10	a, x	x			x	x	
-5	x	x	x	x	x		
0	a, x	d, e, x, f					
10	a, x						
15	a, x						

$\delta_f = 50°$

δ_R	δ_L = 2	0	-3	-4	-5	-7	-10	-15	-20
-15		a, x							
-10		a, x					x	x	x
-5							x	x	x
0		a, j, x	a, x	a	a, b, c, x, d, e, j	x	x		
2.5	x								
5		x							
7.5		x							
10	x	a, x							
15	x	a, x							

Symbol	Designation
x	All gaps open
a	Aileron gap sealed, not faired
b	Flip gap sealed, not faired
c	Flip gap sealed and faired
d	Roughness on bottom of flip
e	3-inch roughness strip forward of flip on upper surface
f	Aileron and flip gap sealed, not faired
g	All gaps sealed and faired
h	Aileron gap unsealed, other gaps sealed
i	Flip gap unsealed; aileron gap sealed but not faired; secondary slot sealed and faired
j	Leading-edge roughness

Note: R = 6,000,000 unless otherwise specified.

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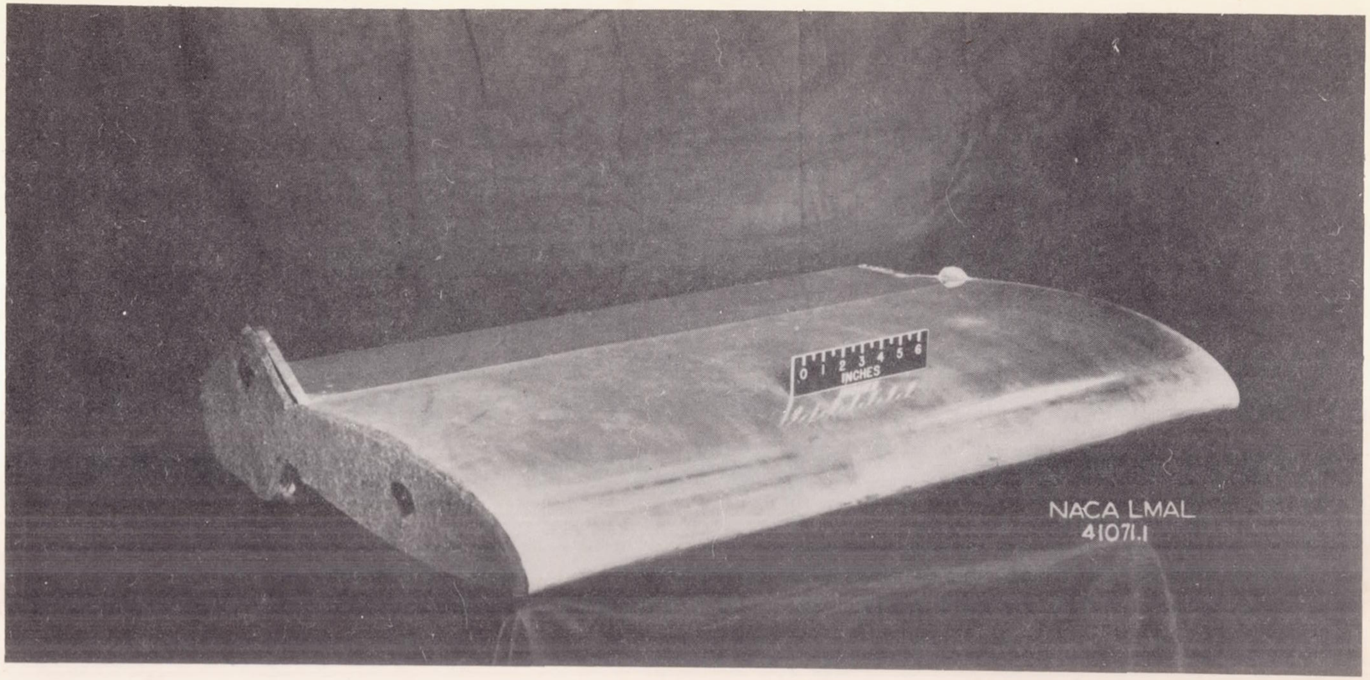

(a) Three-quarters front view of upper surface; $\delta_f = 0^\circ$.

Figure 1.- Photograph of a 24-inch chord Douglas airfoil of NACA 7-series type with double-slotted flap, aileron and flip; station 950 of C-74 wing.

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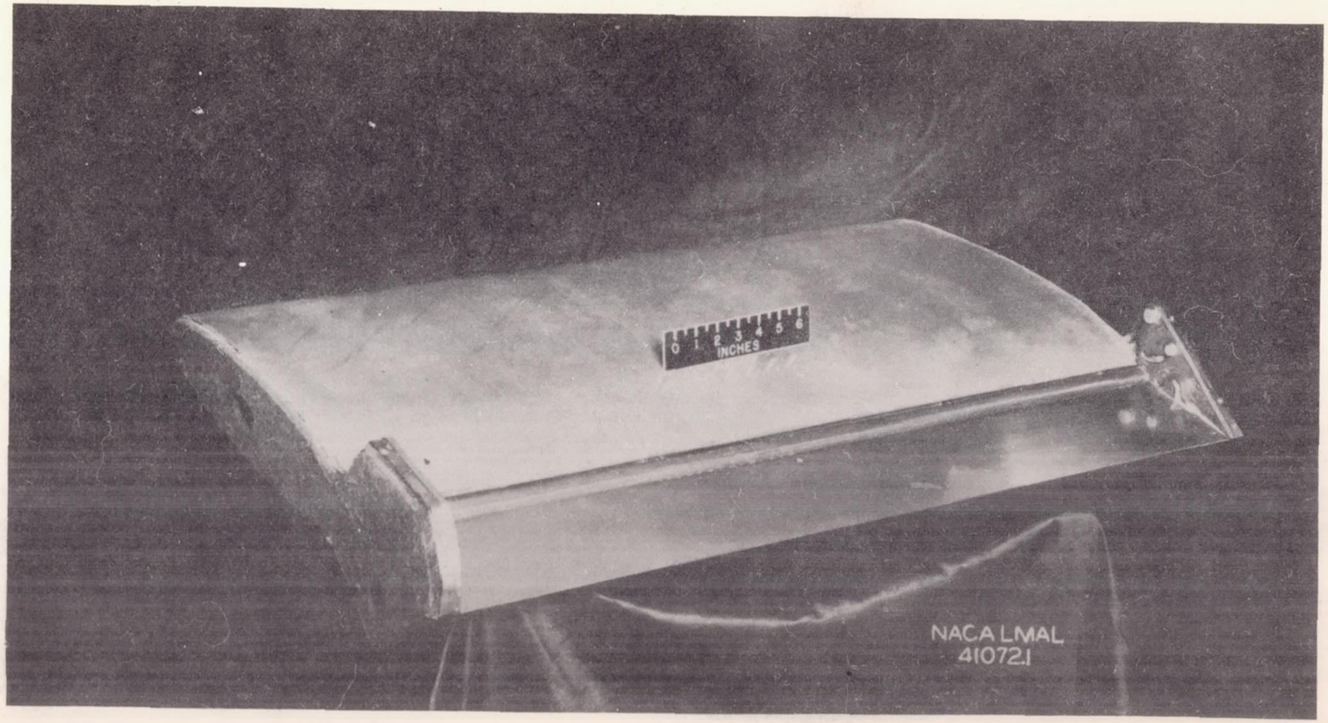
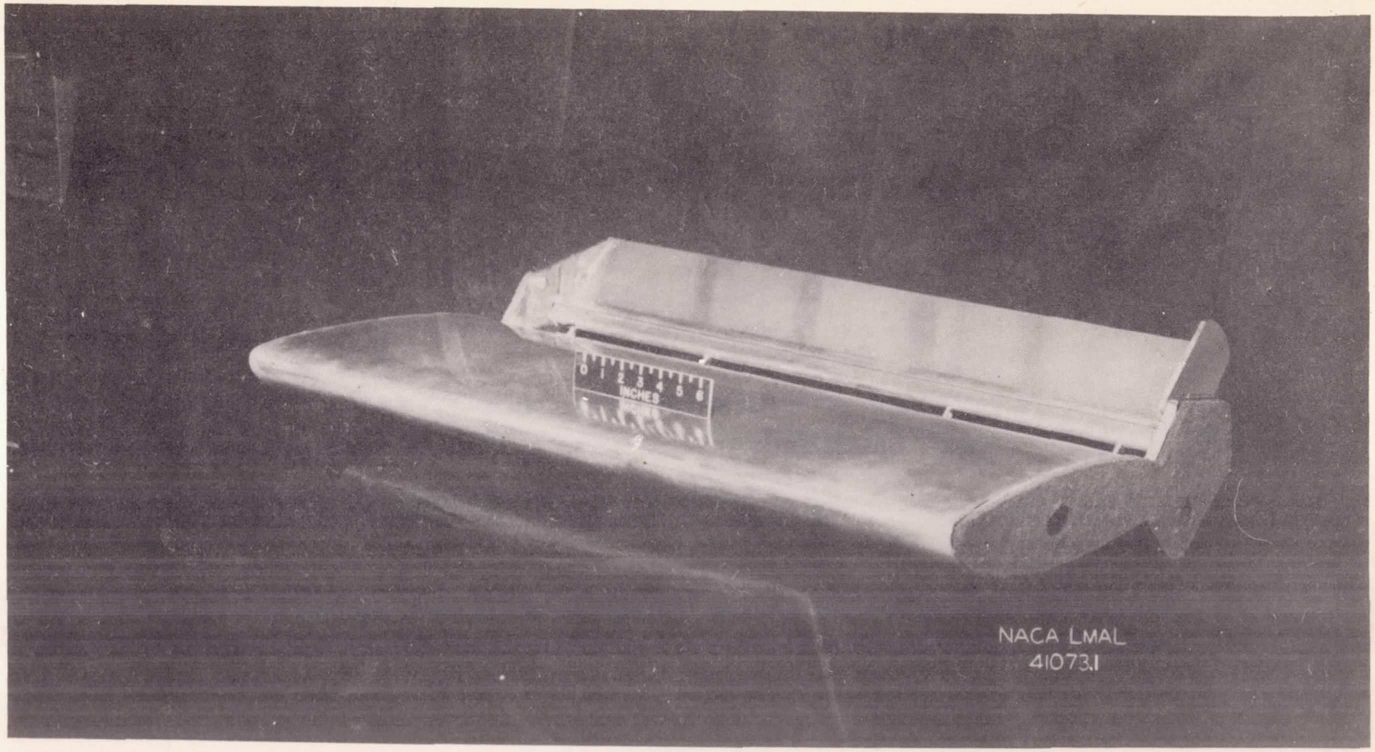


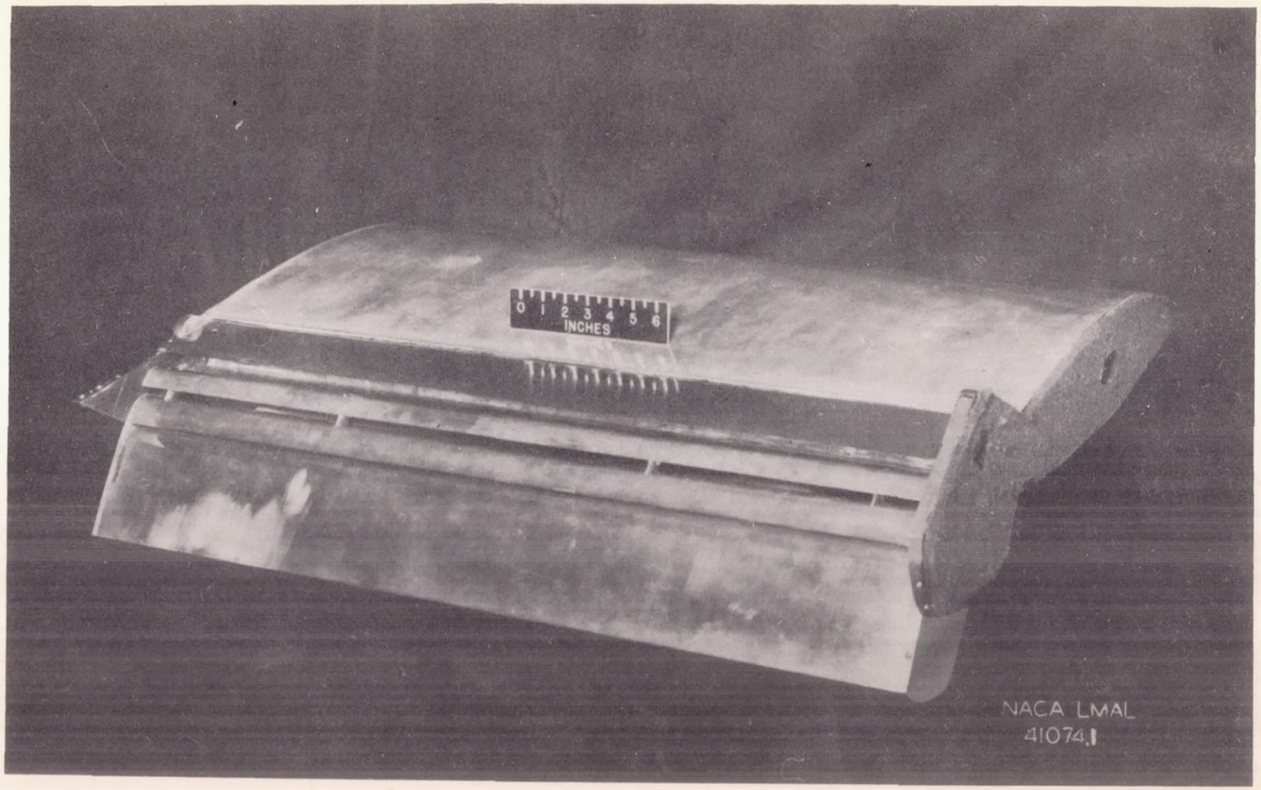
(b) Three-quarters rear view of lower surface; $\delta_f = 0^\circ$.

Figure 1.- Continued.



(c) Three-quarters front view of lower surface; $\delta_f = 50^\circ$.

Figure 1.- Continued.



(d) Three-quarters rear view of upper surface; $\delta_f = 50^\circ$.

Figure 1.- Concluded.

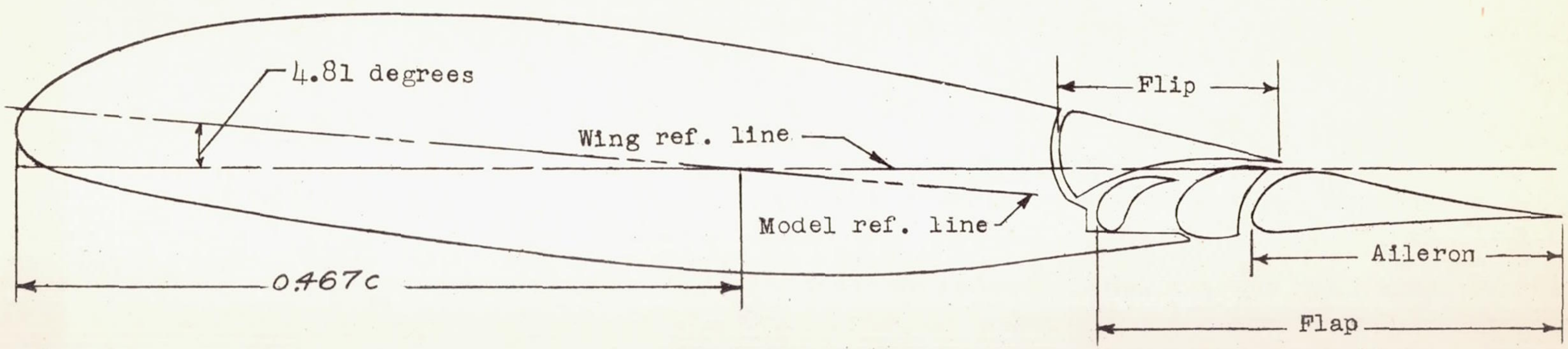


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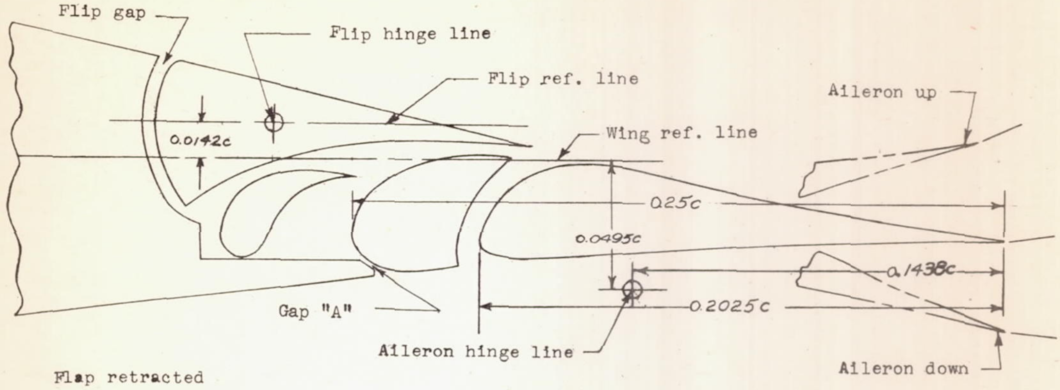
Figure 2.- Profile view of a 24-inch chord Douglas airfoil of NACA 7-series type; station 950 of C-74 wing.



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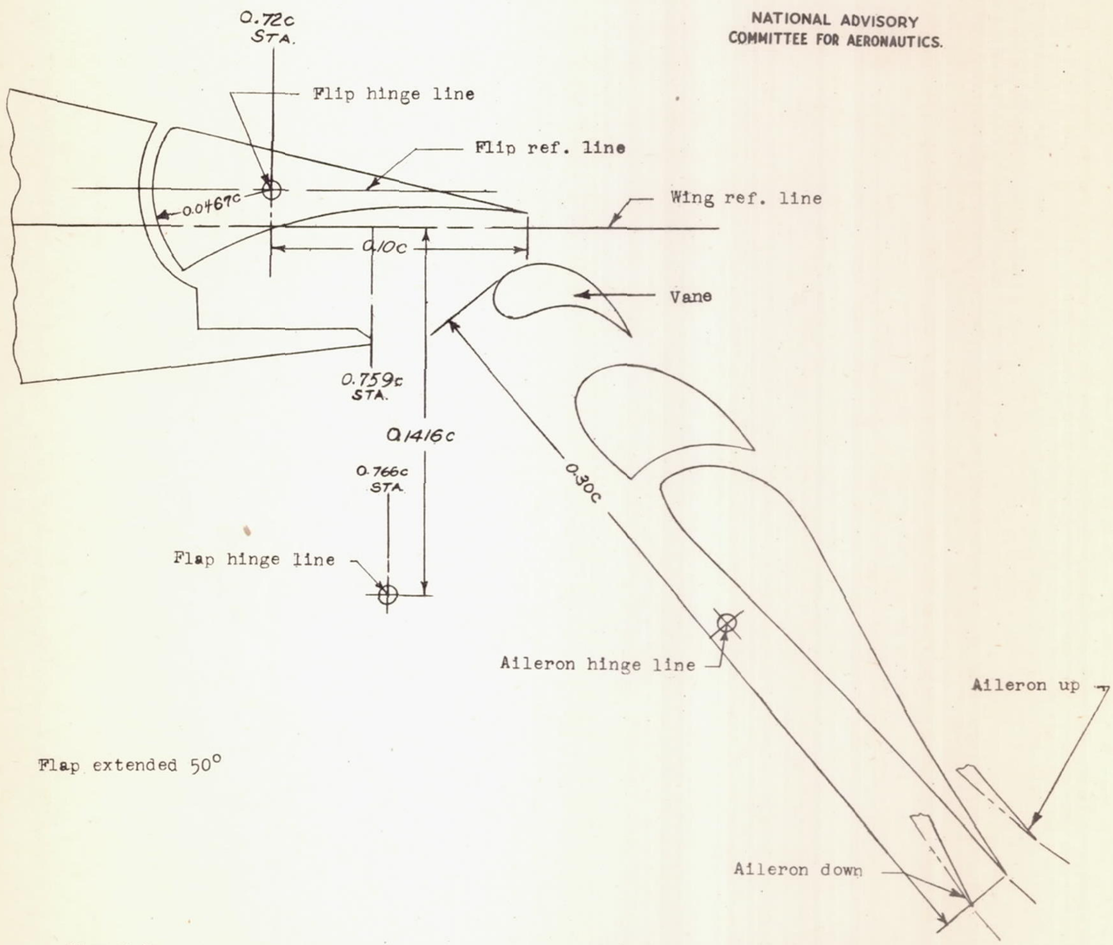


Figure 3.- Arrangement of control surfaces for a 24-inch chord Douglas airfoil of NACA 7-series type; station 950 of C-74 wing.

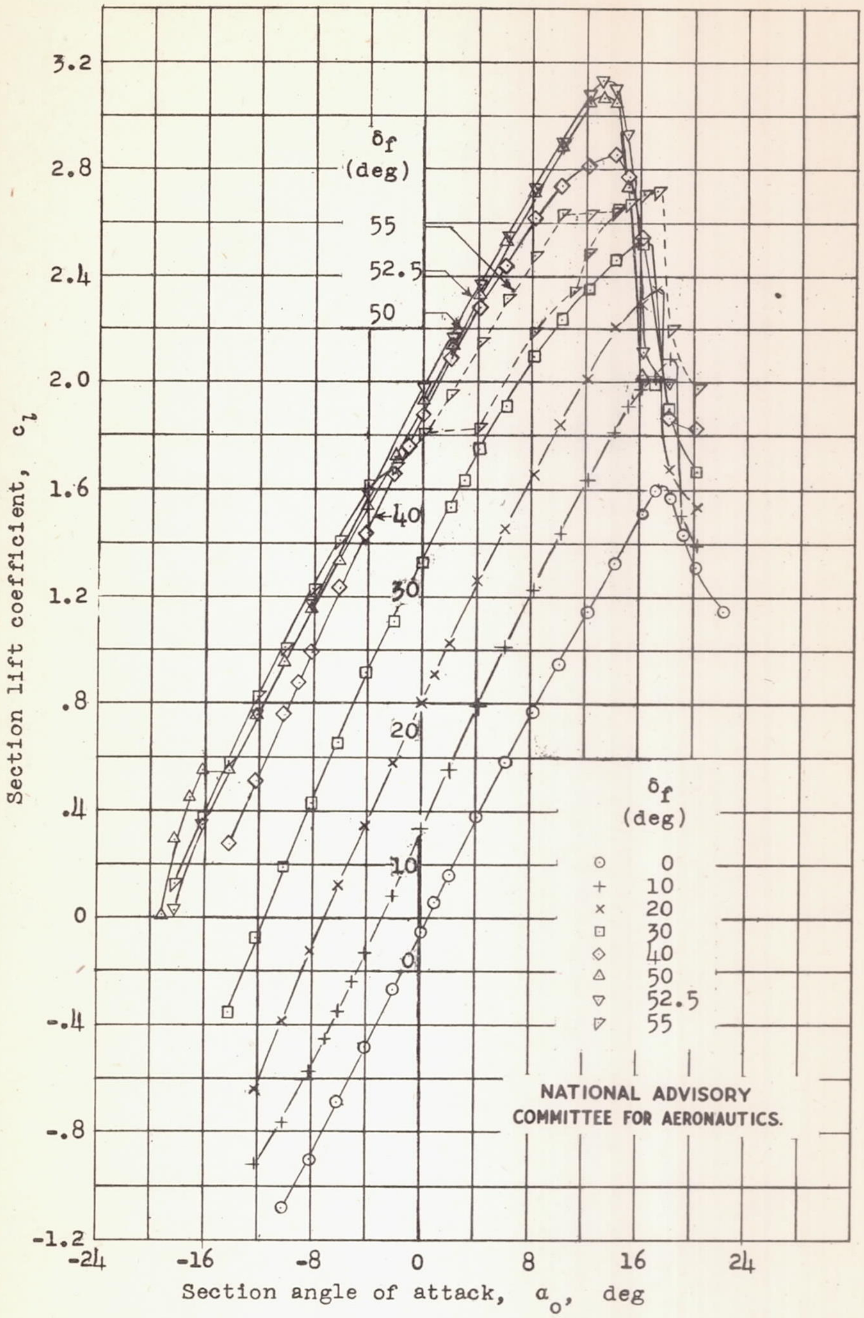
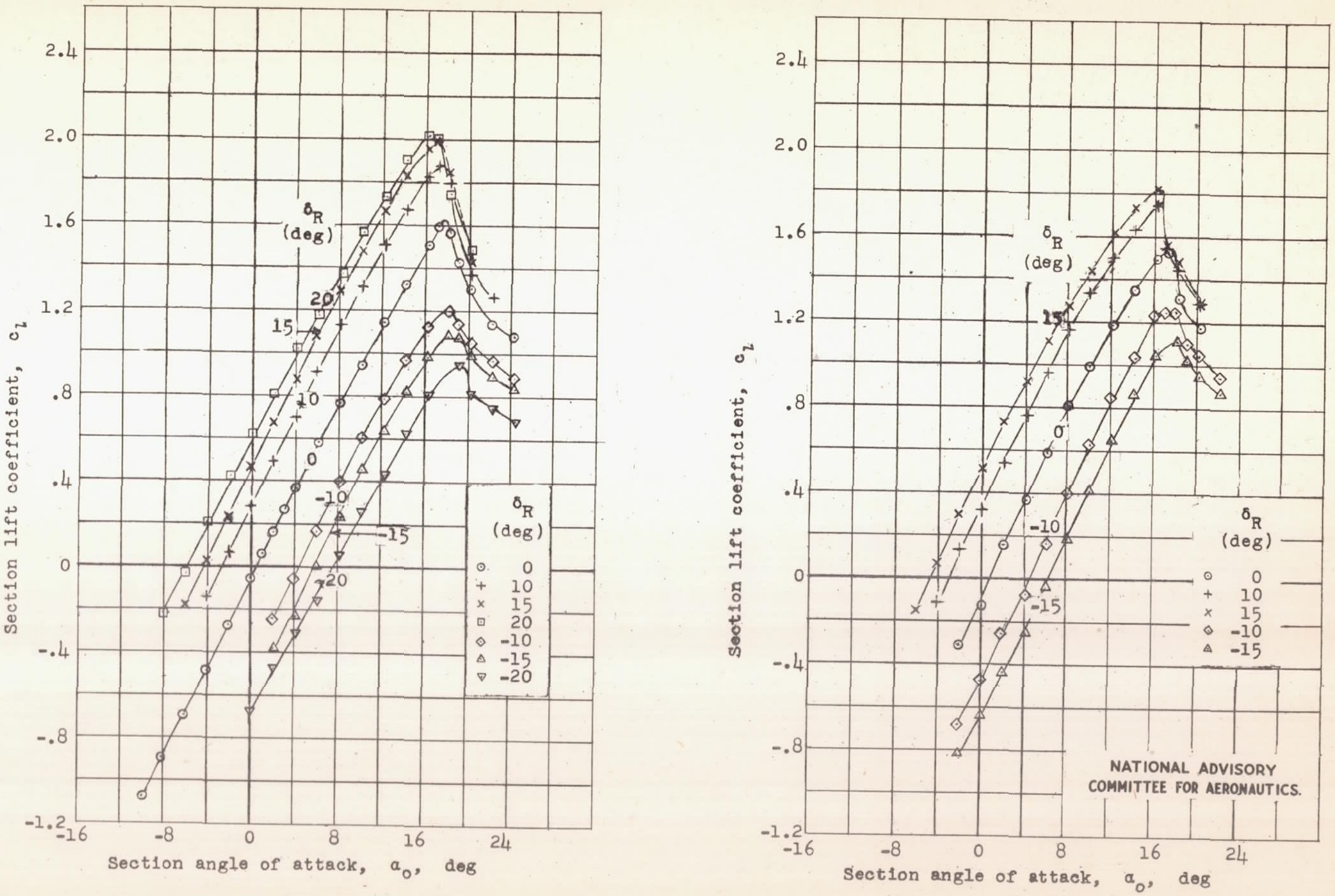


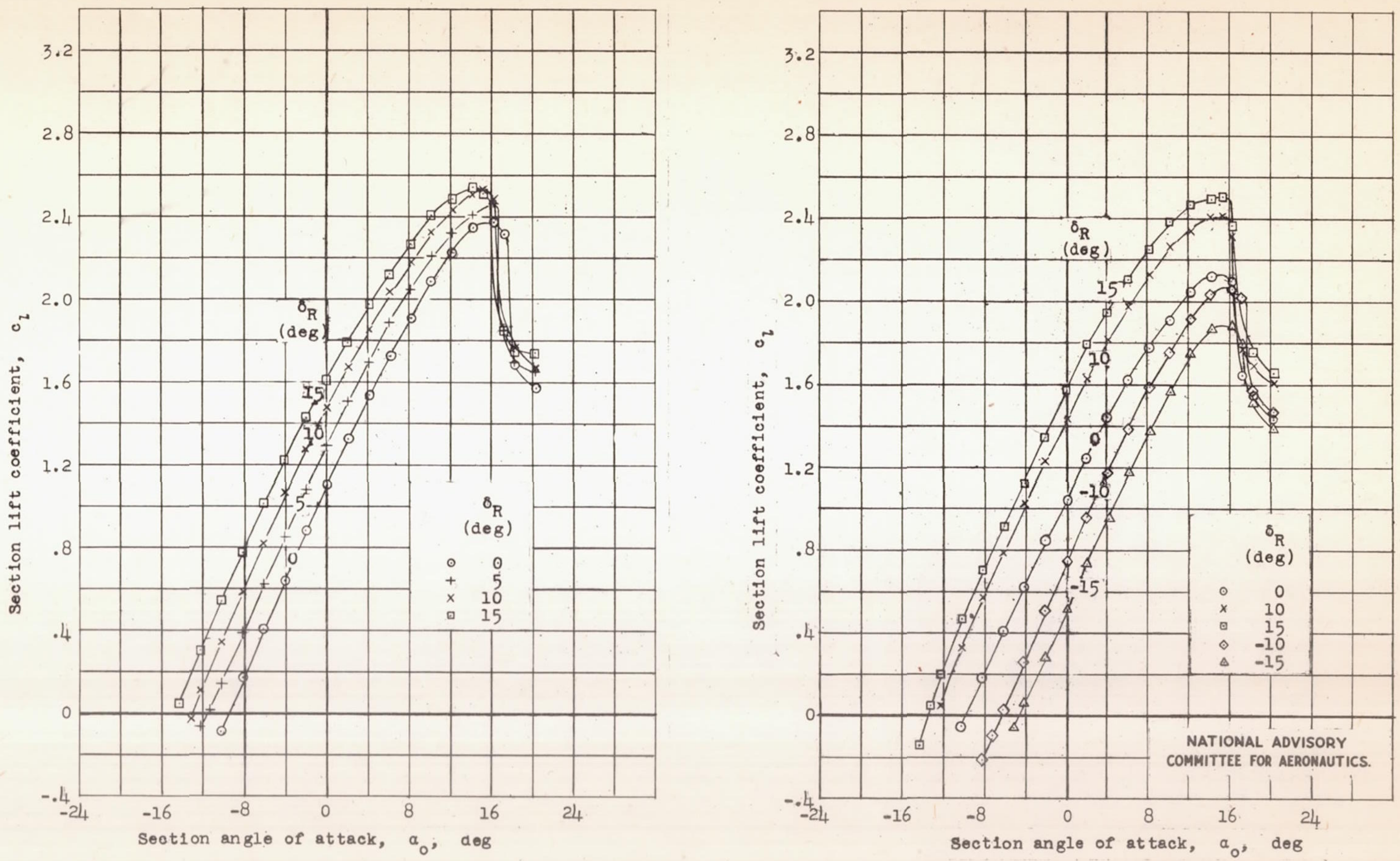
Figure 4 .- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_R = \delta_L = 0$; $R = 6.0 \times 10^6$. Test, TDT 391.



(a) All gaps open.

(b) Aileron gap sealed, not faired.

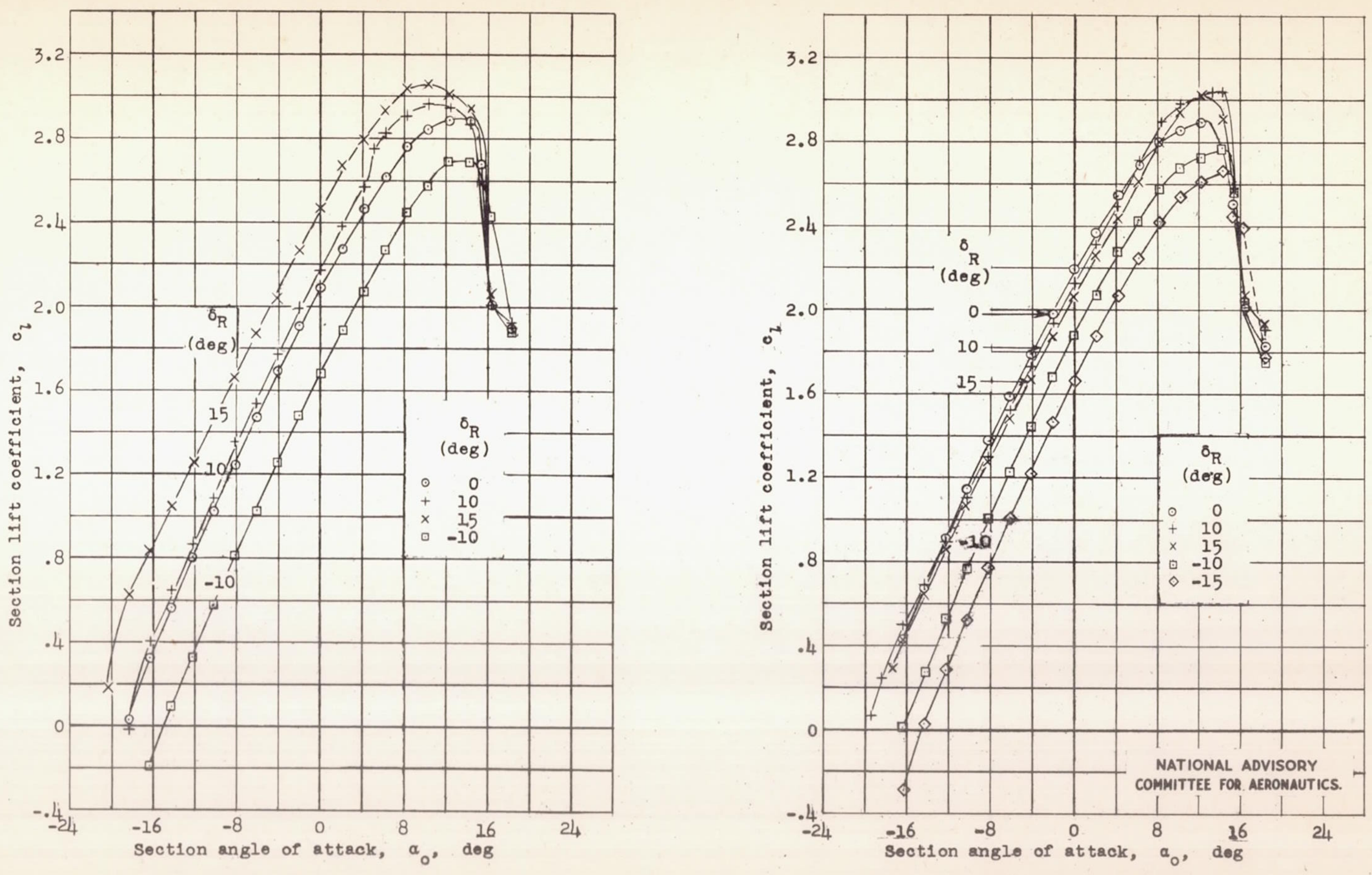
Figure 5.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = \delta_L = 0$; $R = 6 \times 10^6$. Tests, TDT 391 and 395.



(a) All gaps open.

(b) Aileron gap sealed, not faired.

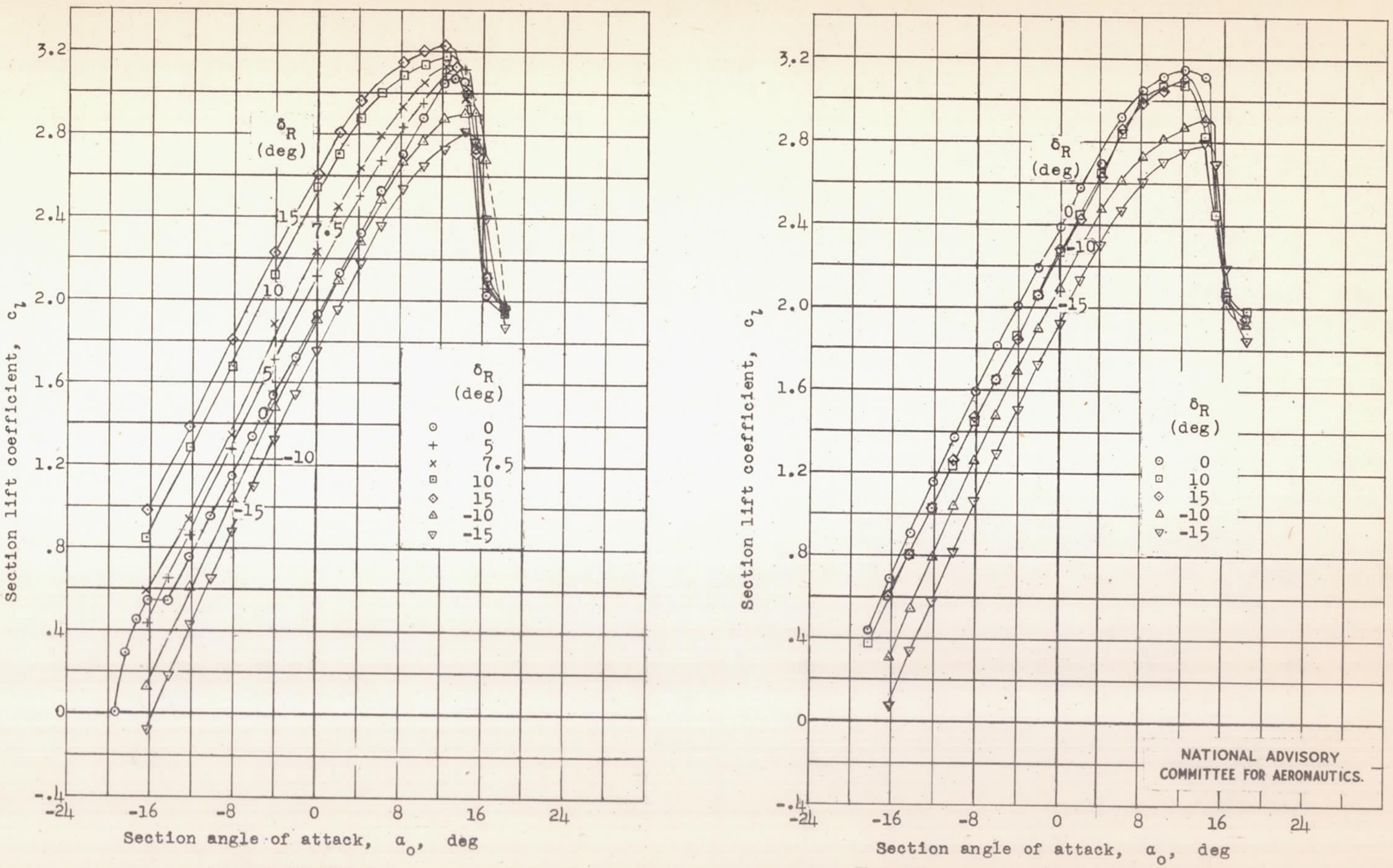
Figure 6 .- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 25^o$; $\delta_L = 0^o$; $R = 6 \times 10^6$. Tests, TDT 391 and 395.



(a) All gaps open.

(b) Aileron gap sealed, not faired.

Figure 7 .- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 45°$; $\delta_L = 0°$; $R = 6 \times 10^6$. Tests, TDT 393 and 395.



(a) All gaps open.

(b) Aileron gap sealed, not faired.

Figure 8 .- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 50^\circ$; $\delta_L = 0^\circ$; $R = 6 \times 10^6$. Tests, TDT 391 and 395.

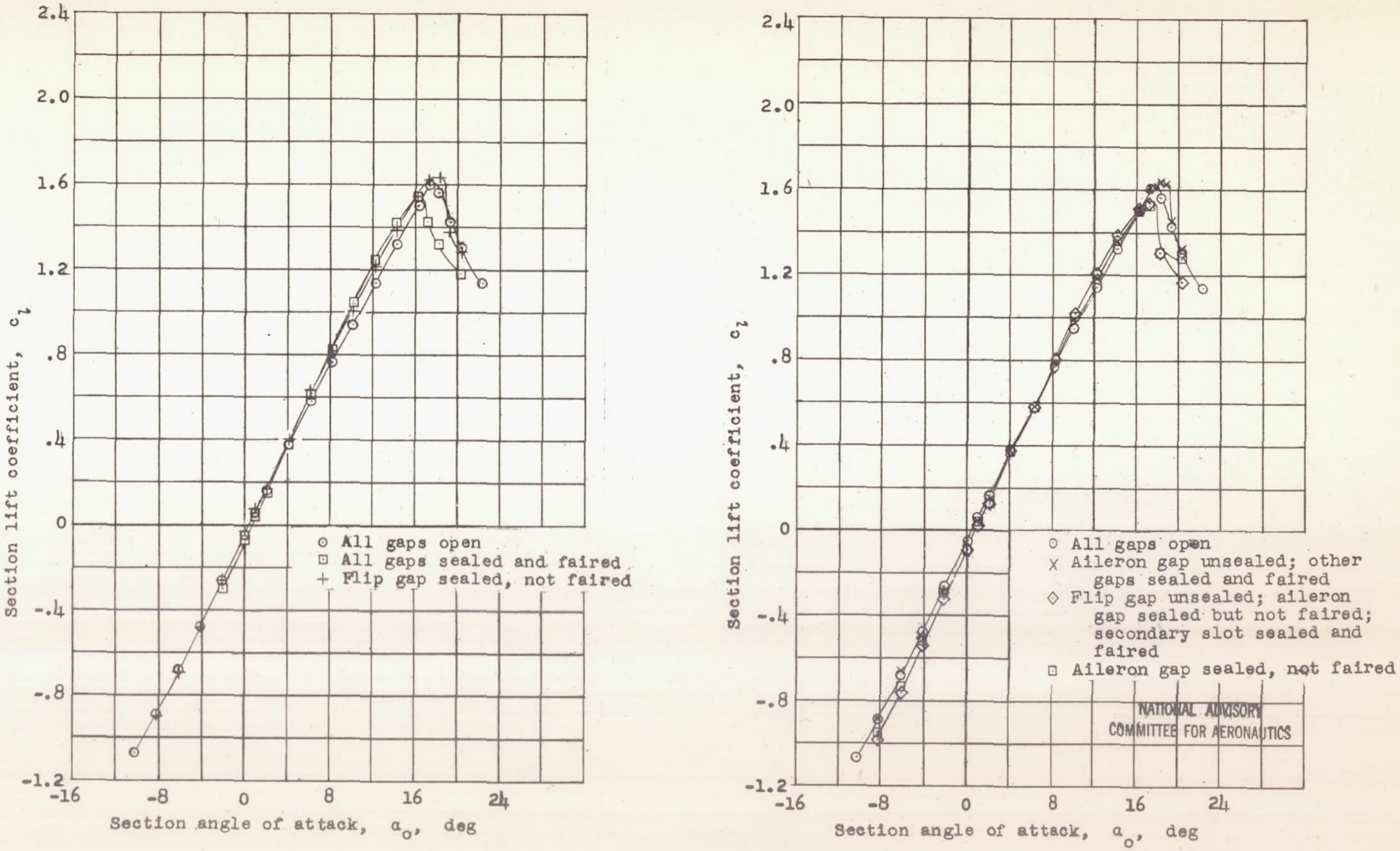
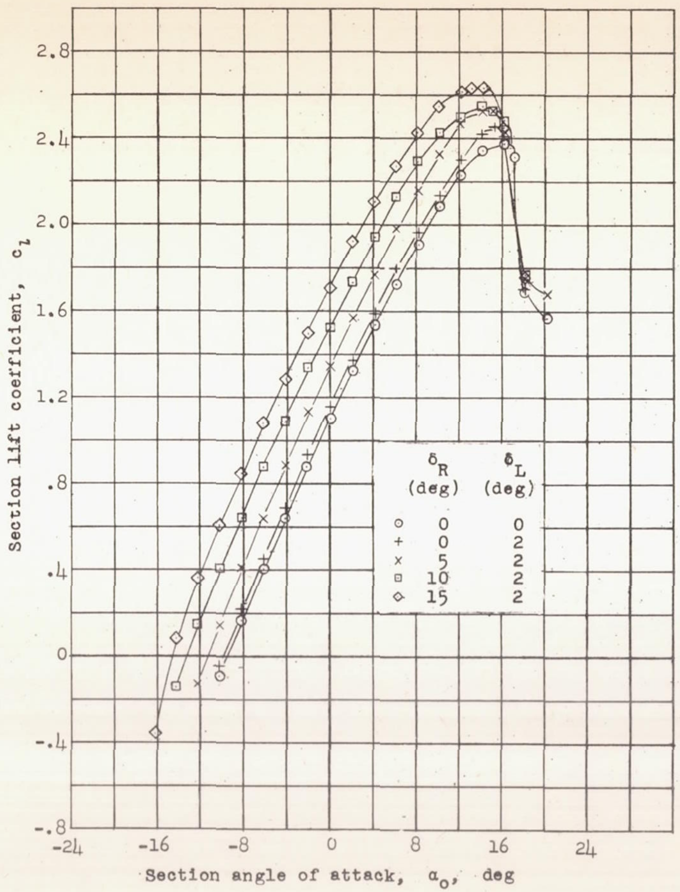


Figure 9.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = \delta_R = \delta_L = 0$; $R = 6 \times 10^6$. Test, TDT 391.



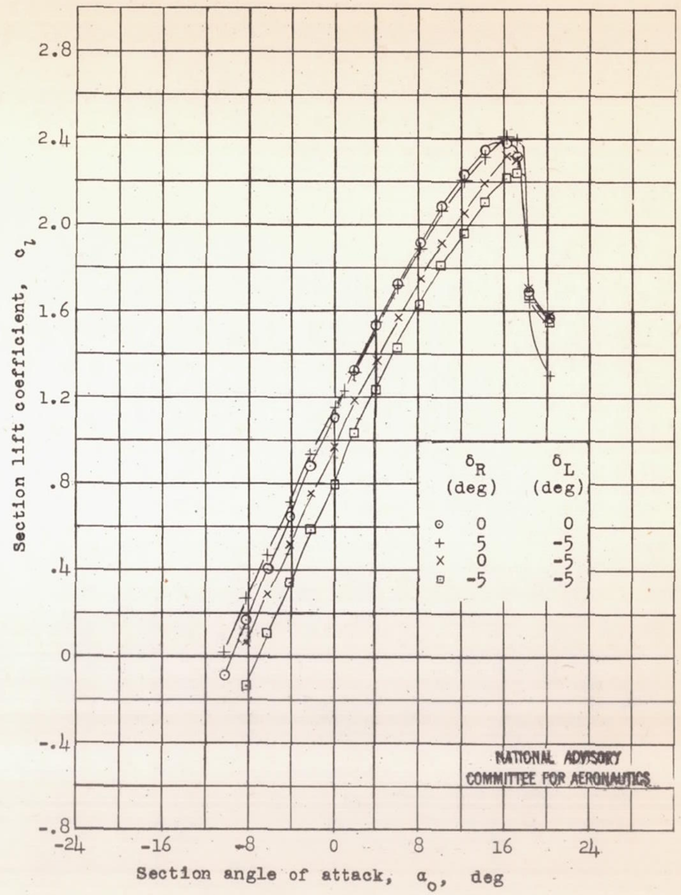


Figure 10.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 25^\circ$; $R = 6 \times 10^6$. Test, TDT 391.

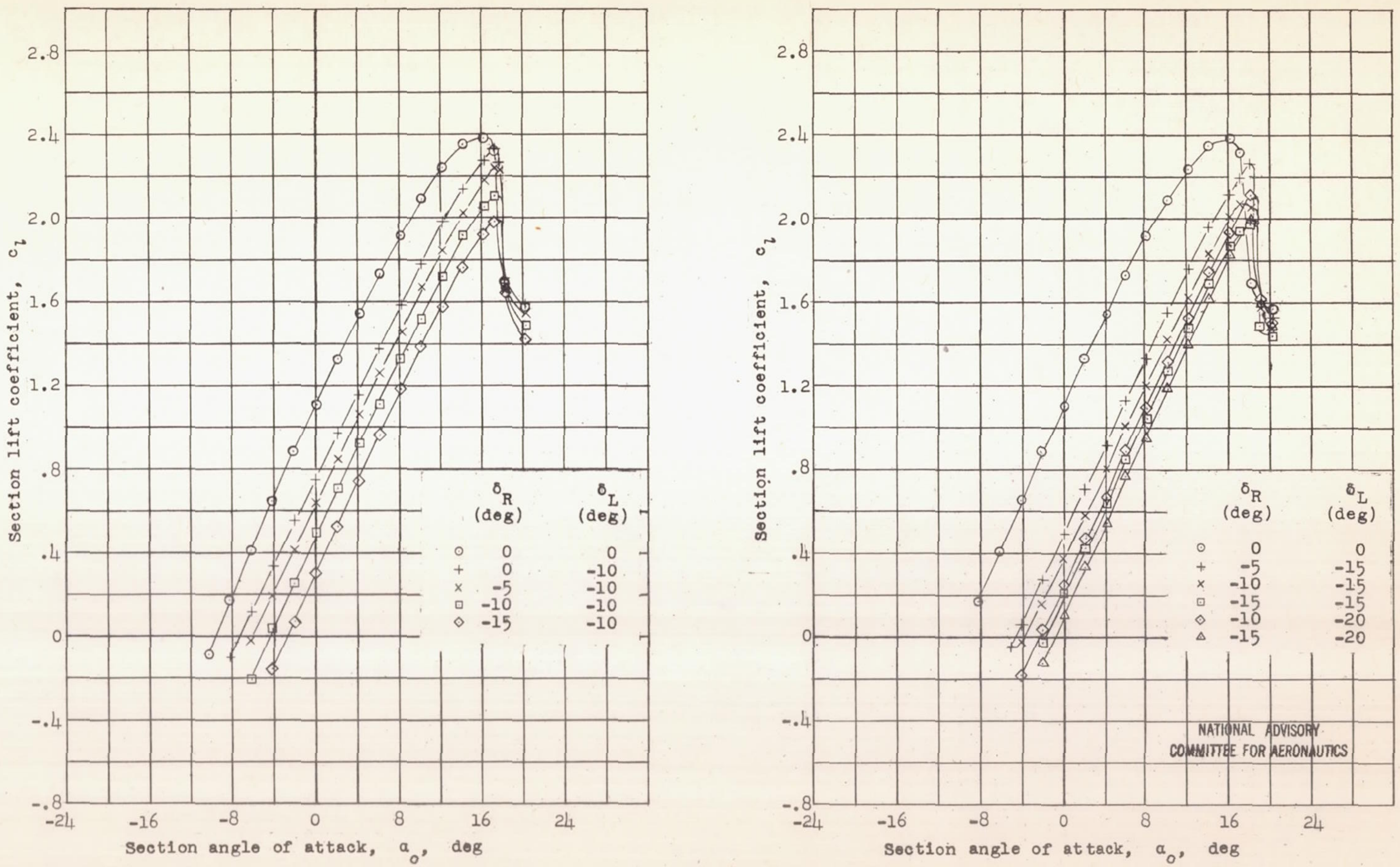
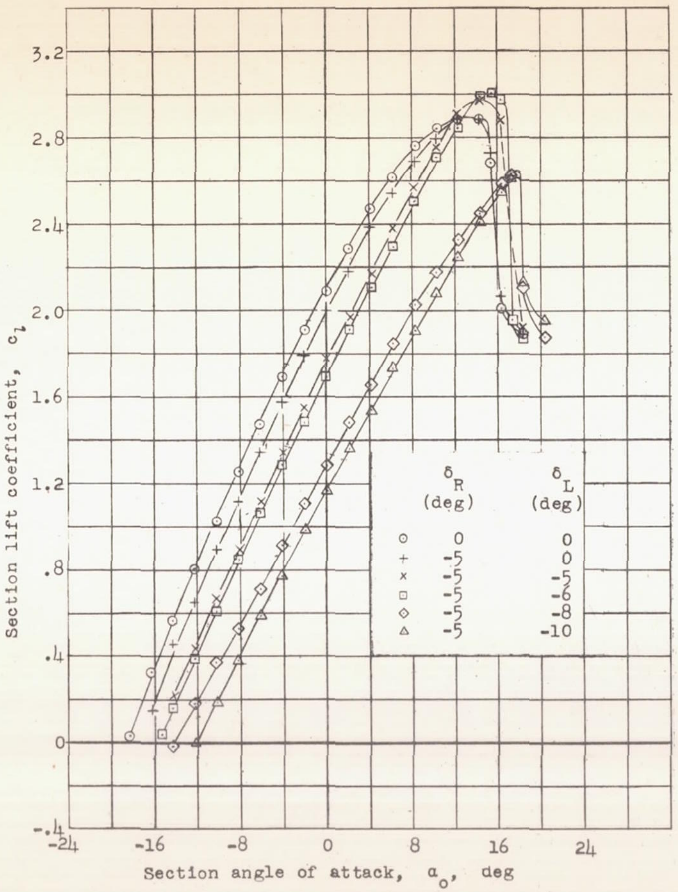


Figure 11 .- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 25^\circ$; $R = 6 \times 10^6$. Test, TDT 391.



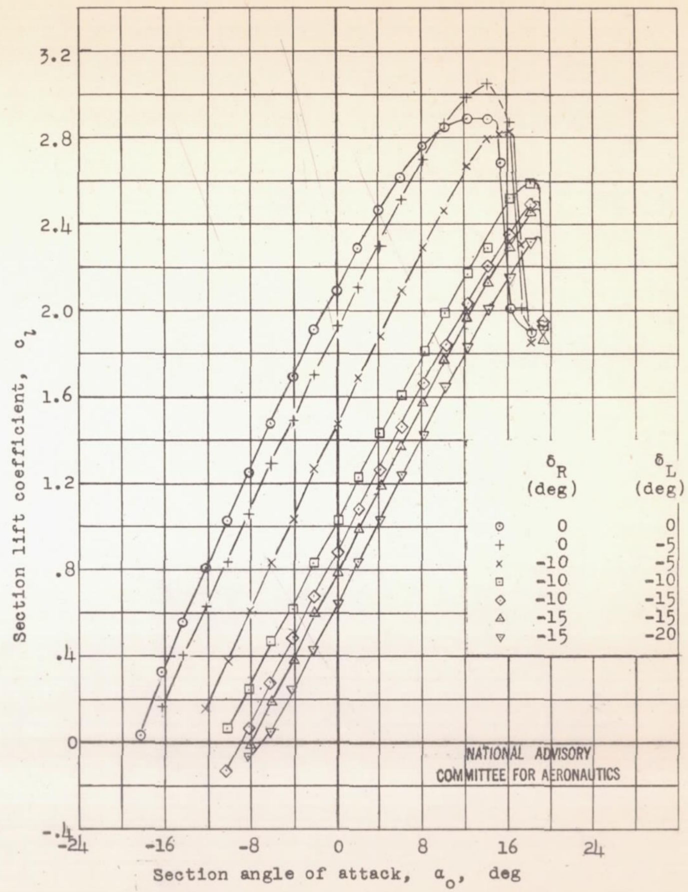


Figure 12.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 45°$; $R = 6 \times 10^6$. Test, TDT 393.

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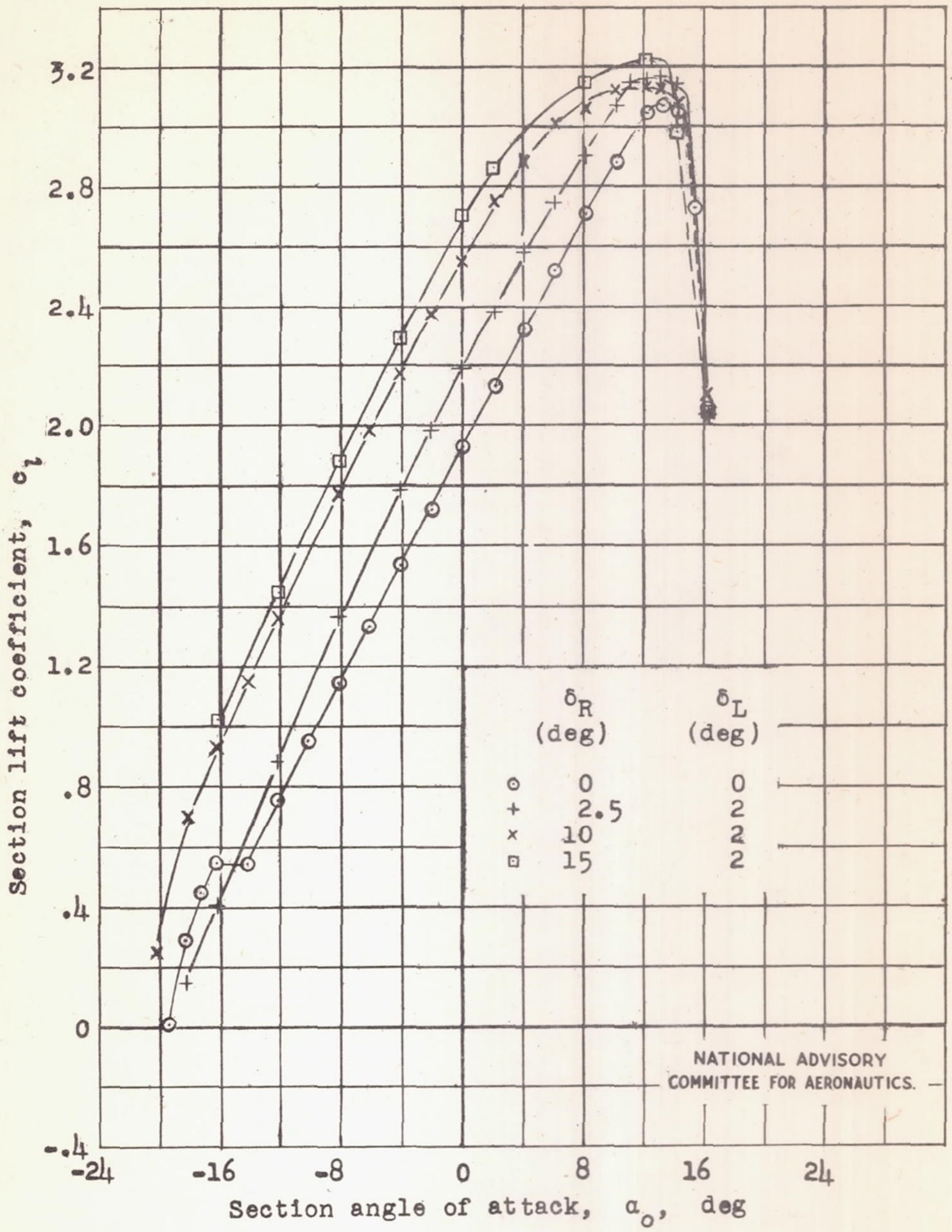
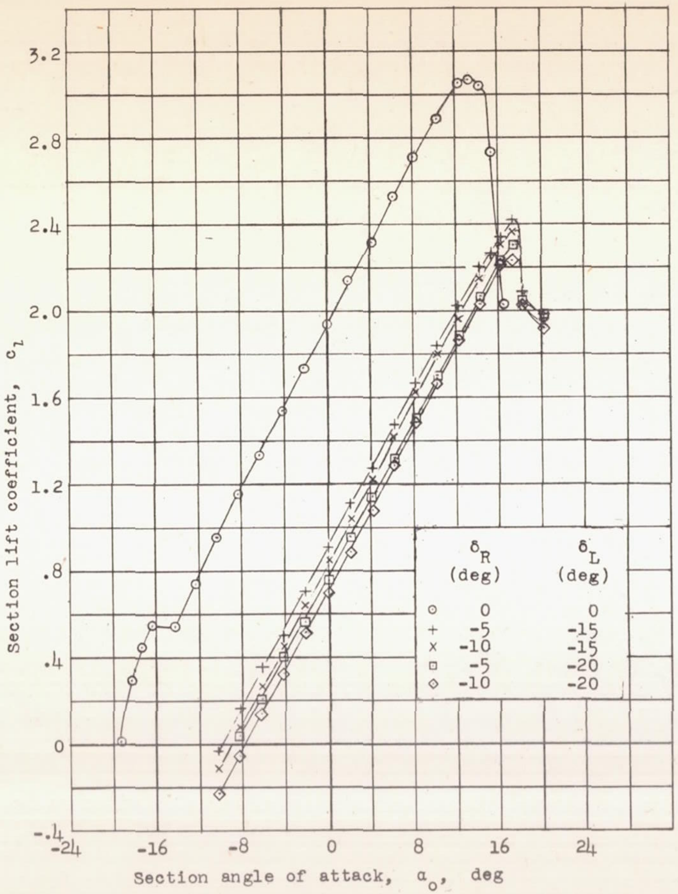


Figure 13.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 50^o$; $R = 6 \times 10^6$. Test, TDT 391.



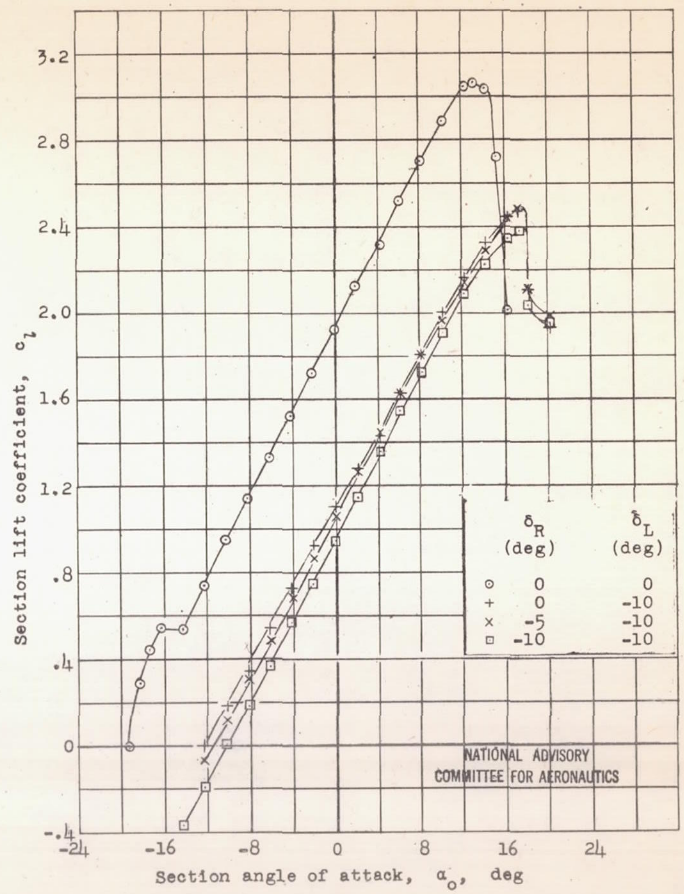
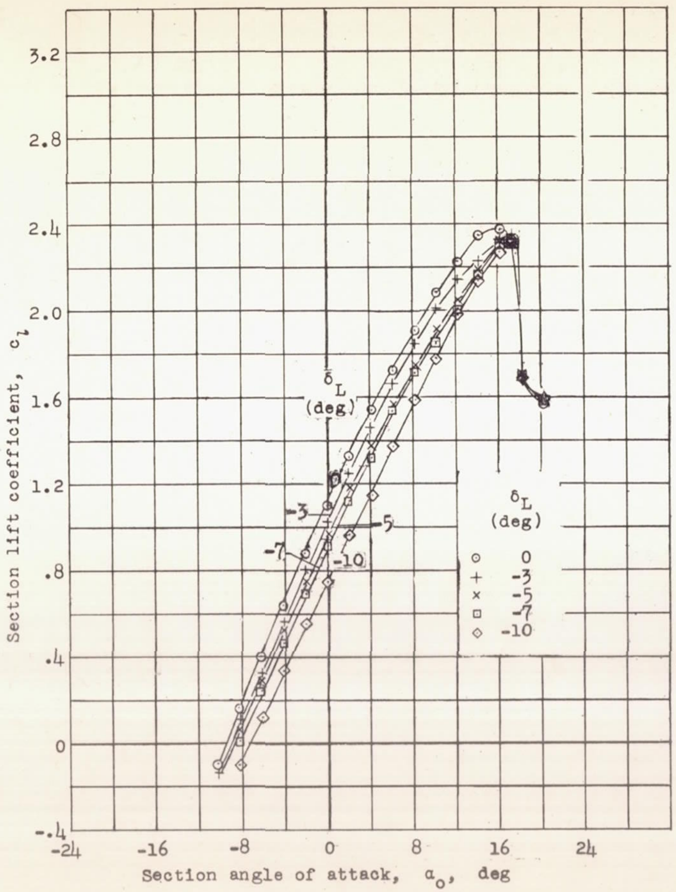
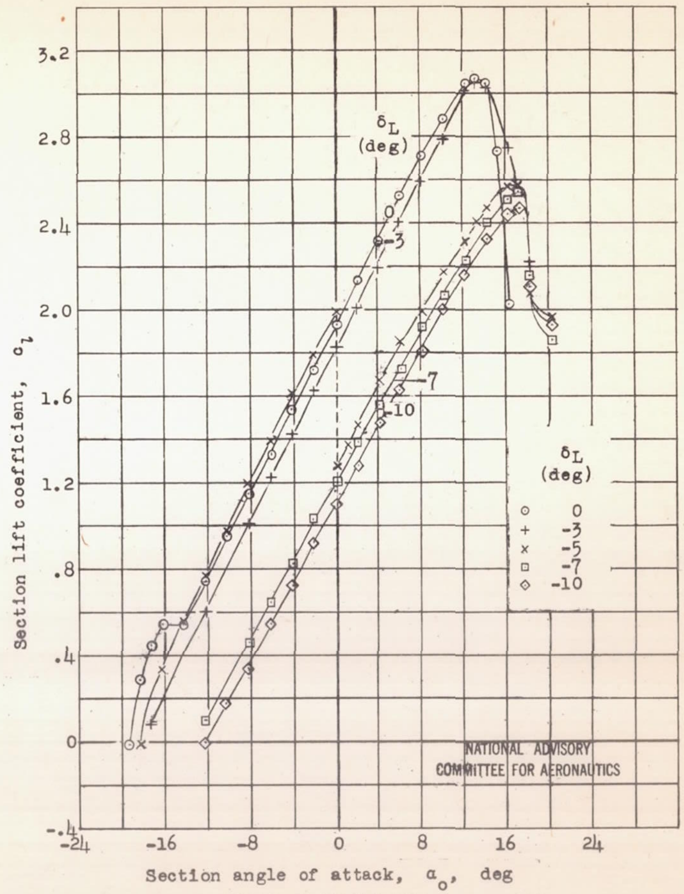


Figure 14.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 50^\circ$; $R = 6 \times 10^6$. Test, TDT 391.



(a) $\delta_f = 25^{\circ}$.



(b) $\delta_f = 50^{\circ}$.

Figure 15.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_R = 0$; $R = 6 \times 10^6$. Test, TDT 391.

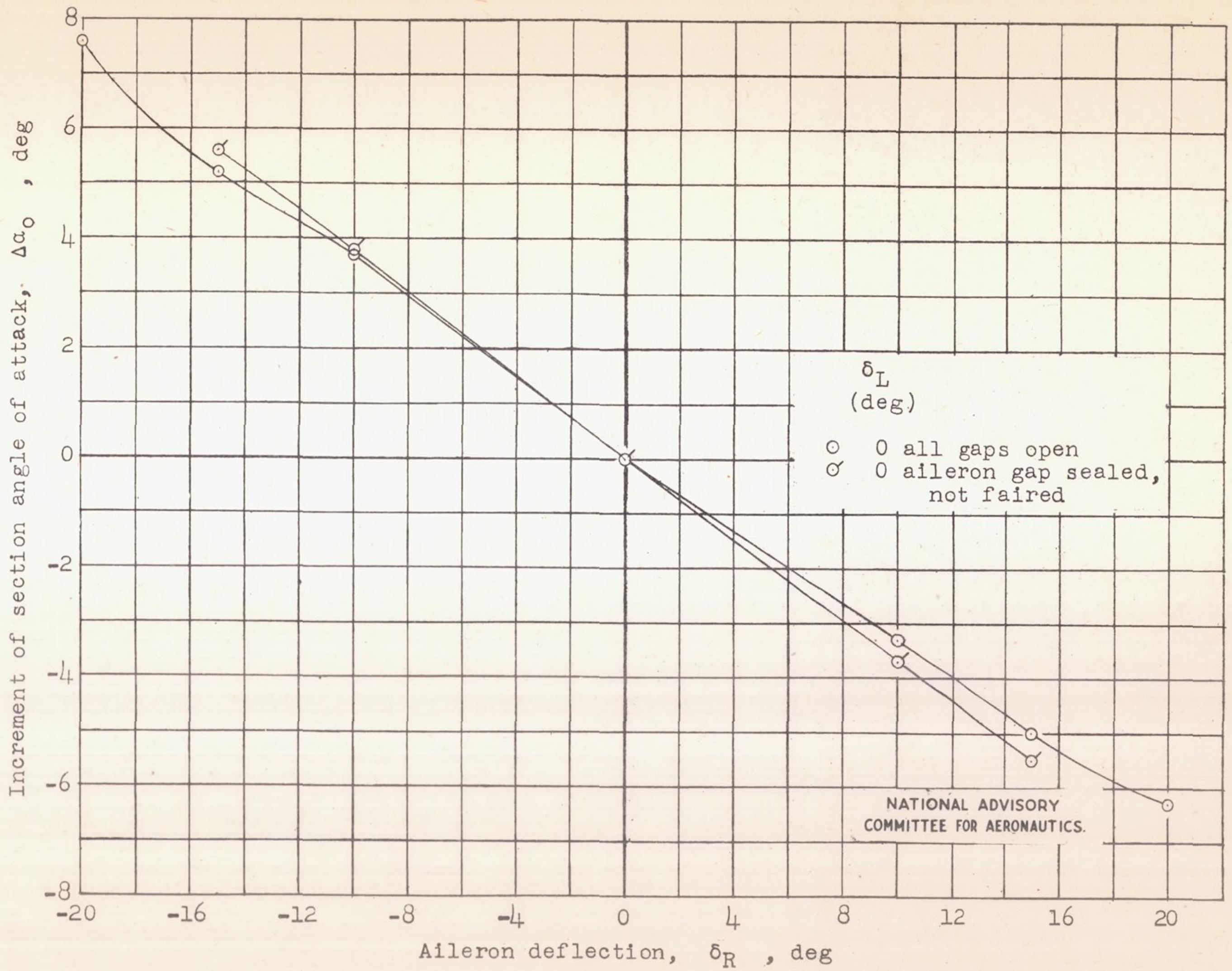


Figure 16.- Aileron and flip effectiveness of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 0^{\circ}$; $c_l = 0.4$; $R = 6 \times 10^6$. Tests, TDT 391, 393, 395.

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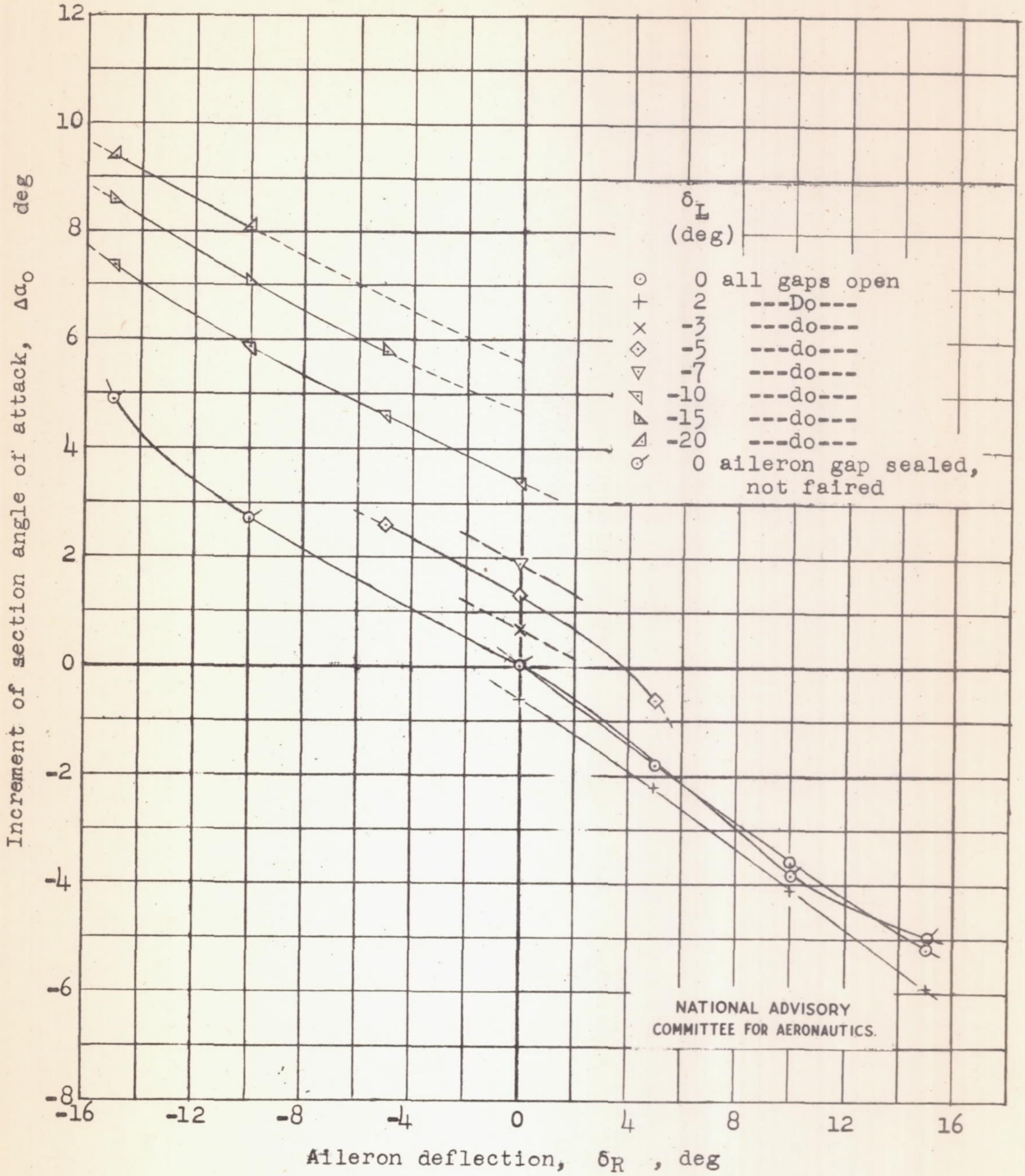

Figure 17.- Aileron and flip effectiveness of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 25^\circ$; $c_l = 1.1$; $R = 6 \times 10^6$. Tests, TDT 391, 393, 395.

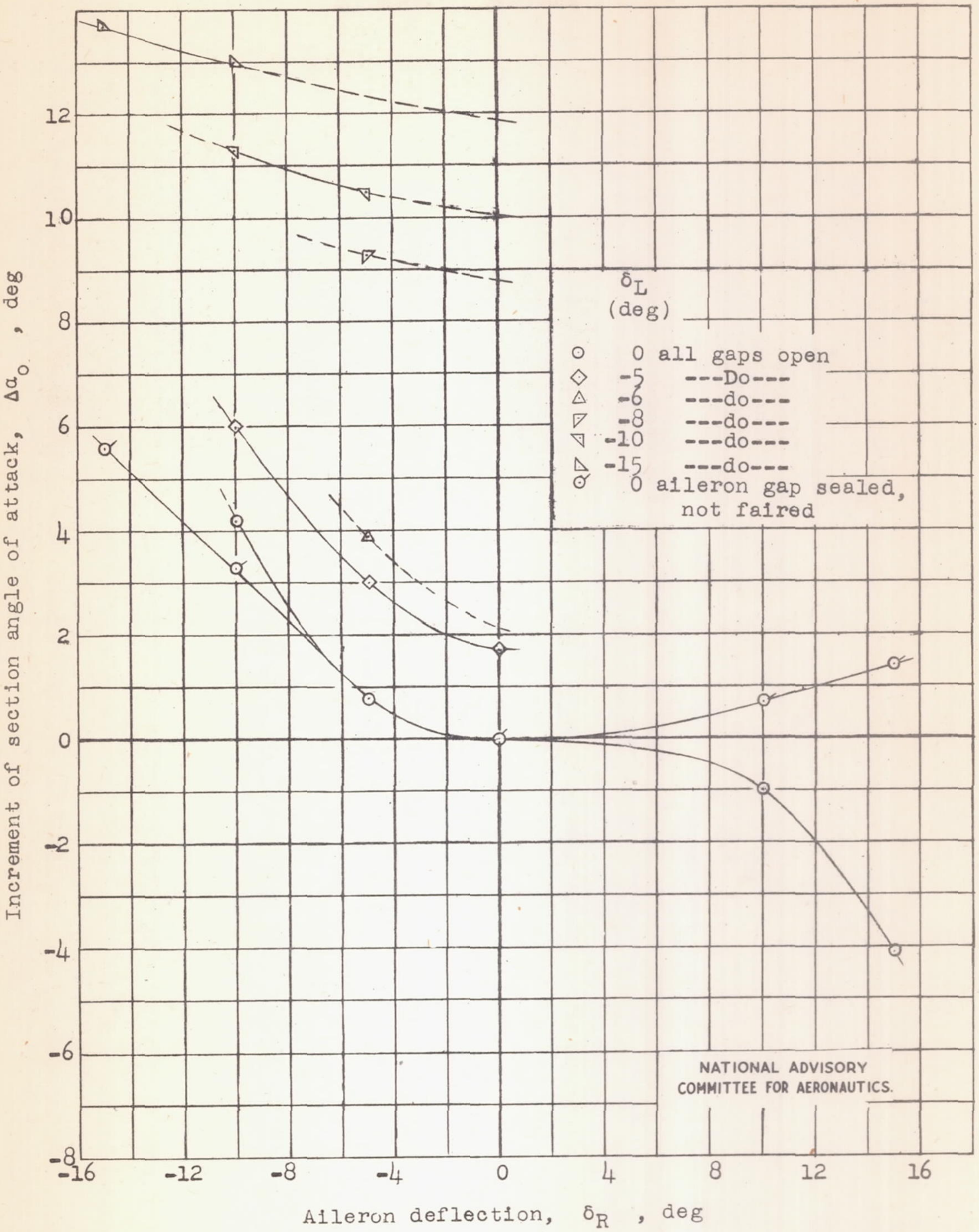

Figure 18.- Aileron and flip effectiveness of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 45^\circ$; $c_l = 2.2$; $R = 6 \times 10^6$. Tests, TDT 393, 395.

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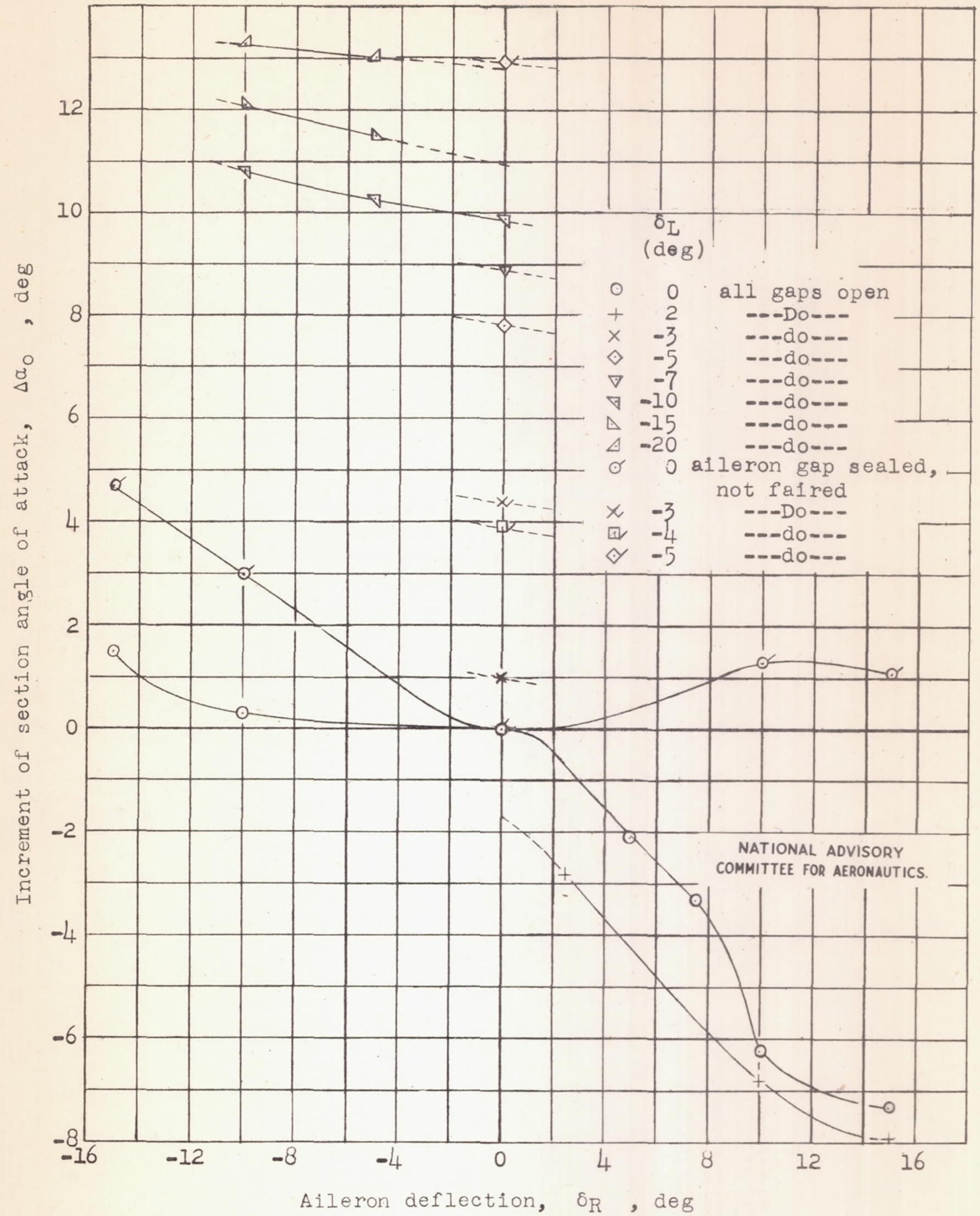

Figure 19.- Aileron and flip effectiveness of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 50^o$; $c_l = 2.2$; $R = 6 \times 10^6$. Tests, TDT 391, 395.

L-641

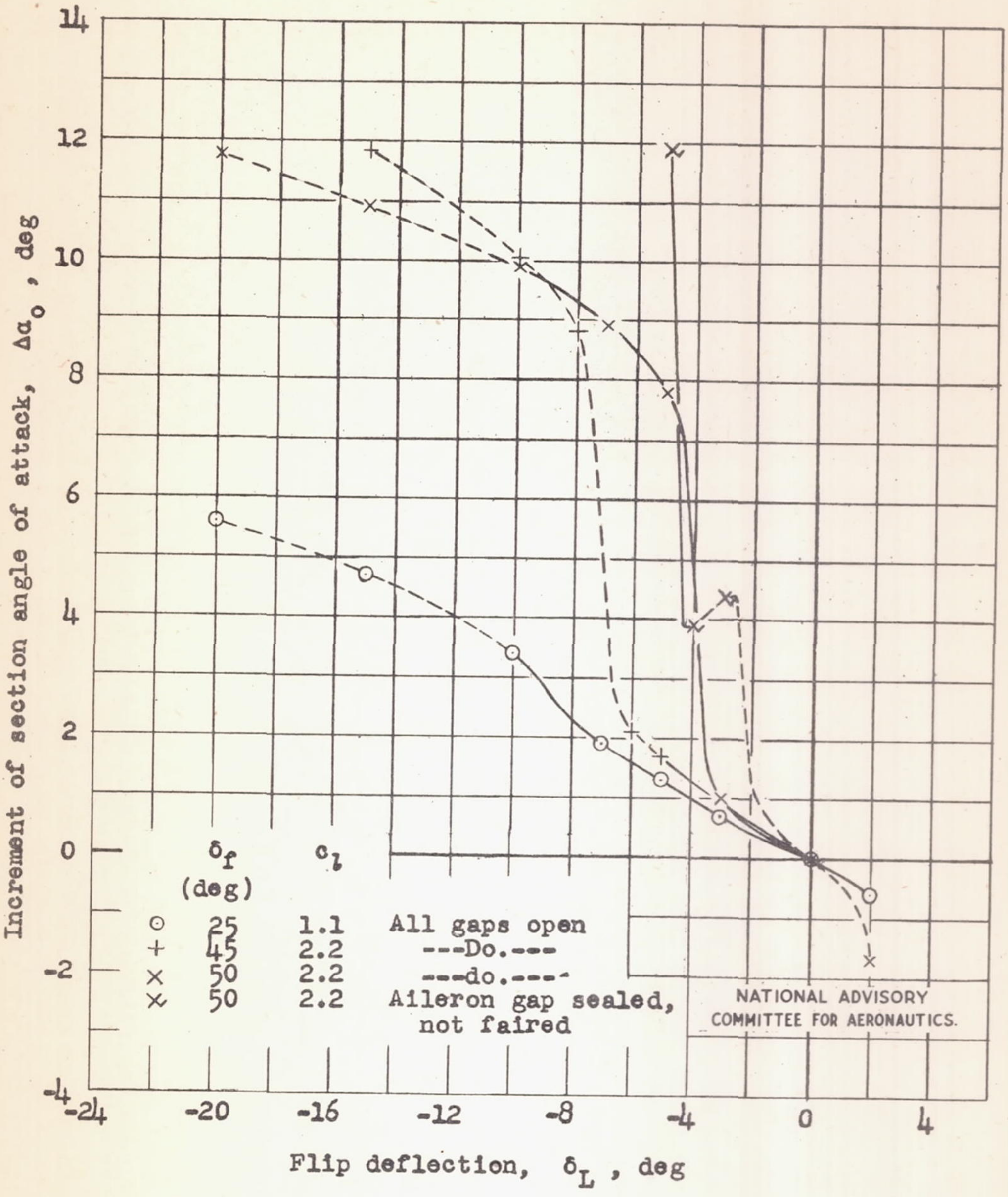

Figure 20.- Flip effectiveness of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_R = 0^o$; $R = 6 \times 10^6$. Tests, TDT 391, 393, 395.

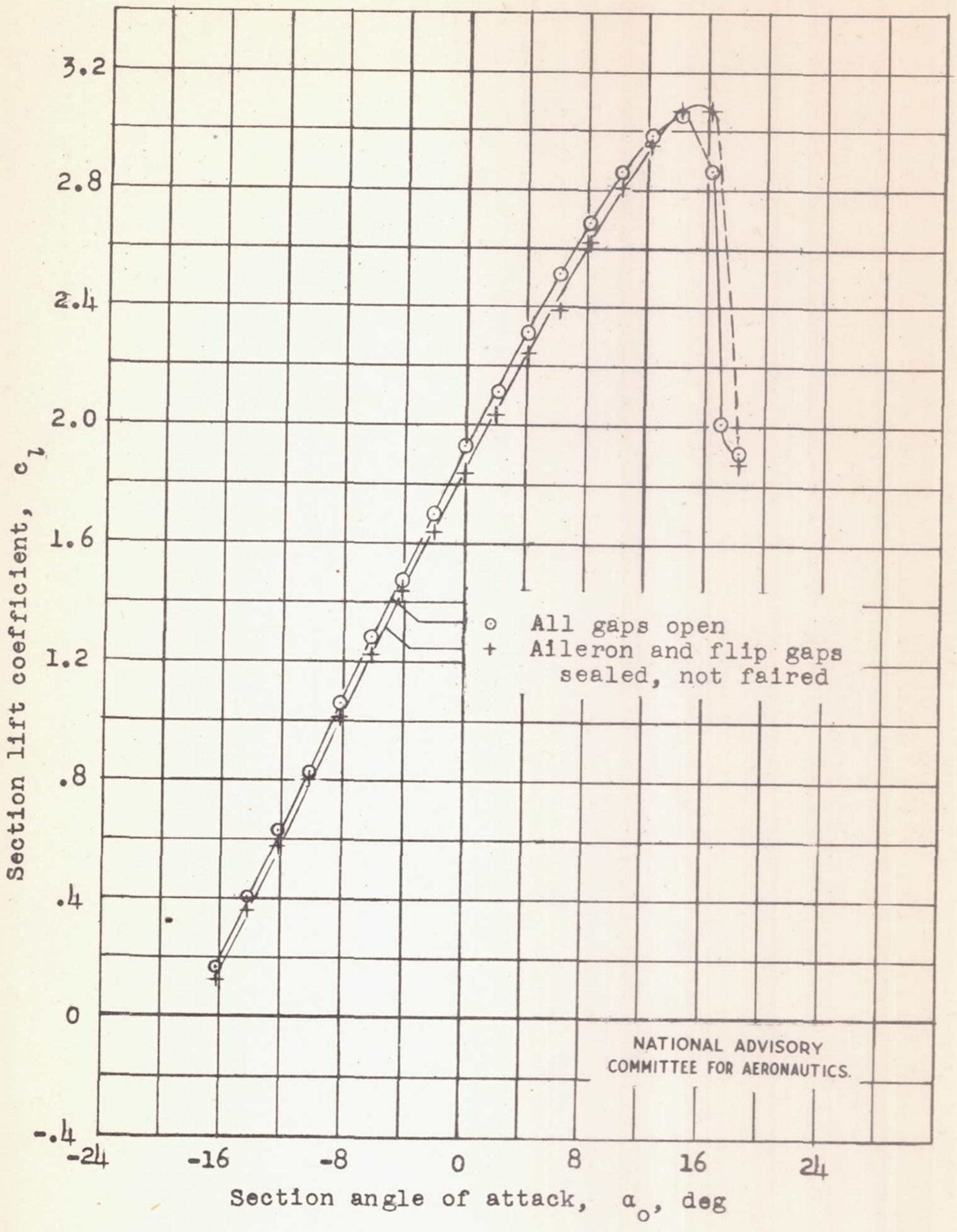

Figure 21.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 45^o$; $\delta_R = 0^o$; $\delta_L = -5^o$; $R = 6 \times 10^6$. Tests, TDT 393 and 395.

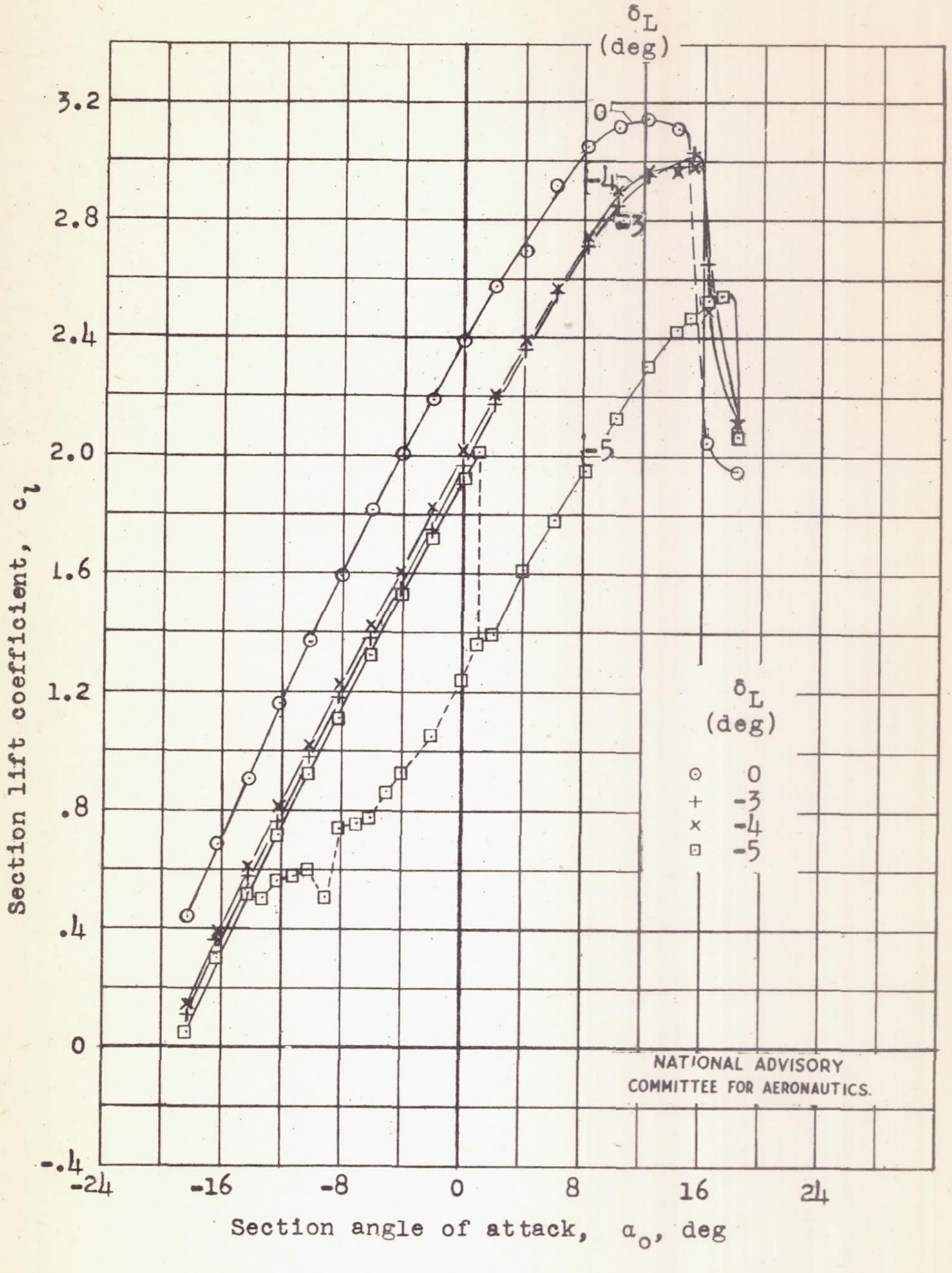

Figure 22.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. Aileron gap sealed, not faired; $\delta_f = 50^\circ$; $\delta_R = 0^\circ$; $R = 6 \times 10^6$. Tests, TDT 391 and 393.

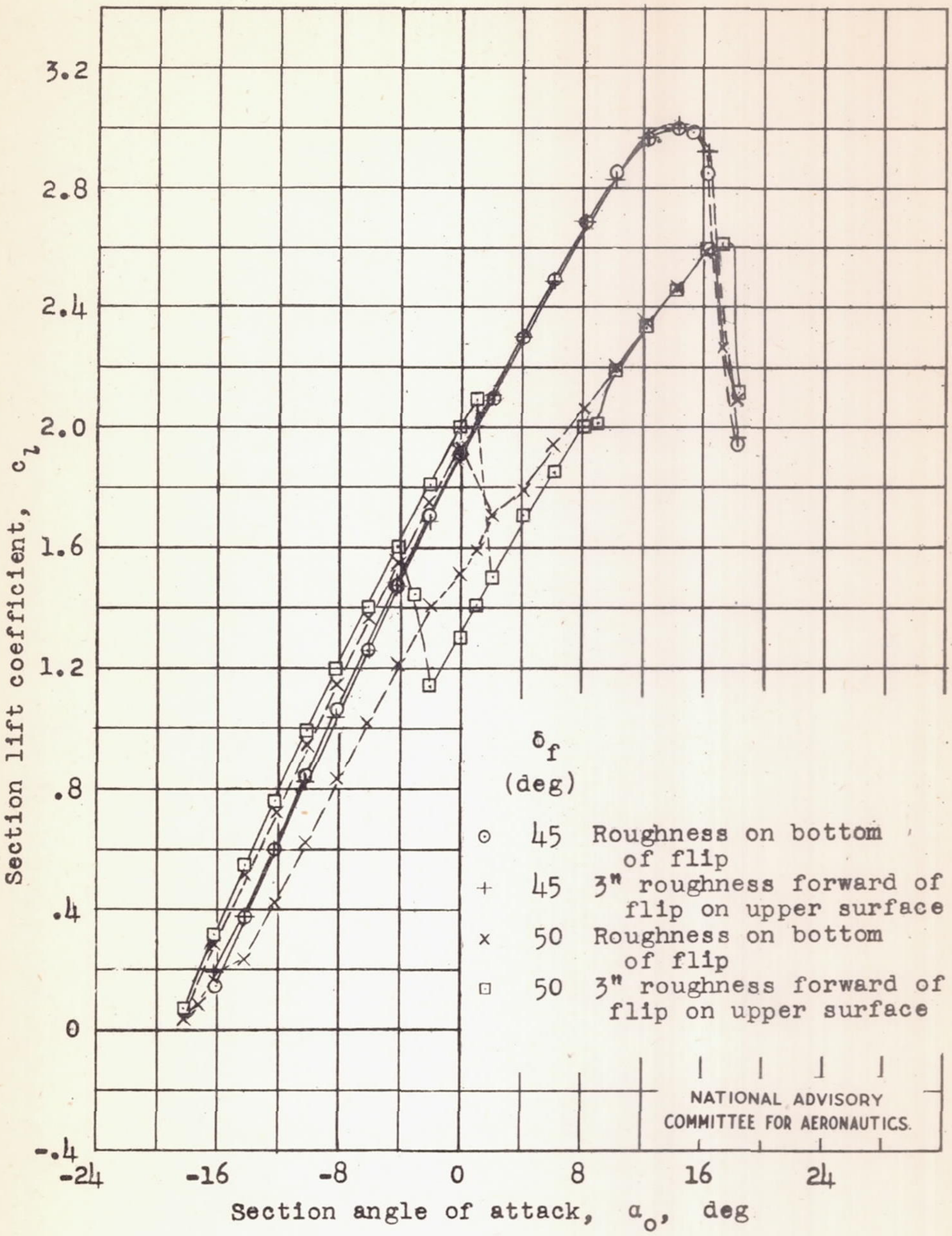

Figure 23.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_R = 0$; $\delta_L = -5^\circ$; $R = 6 \times 10^6$ Test, TDT 393.

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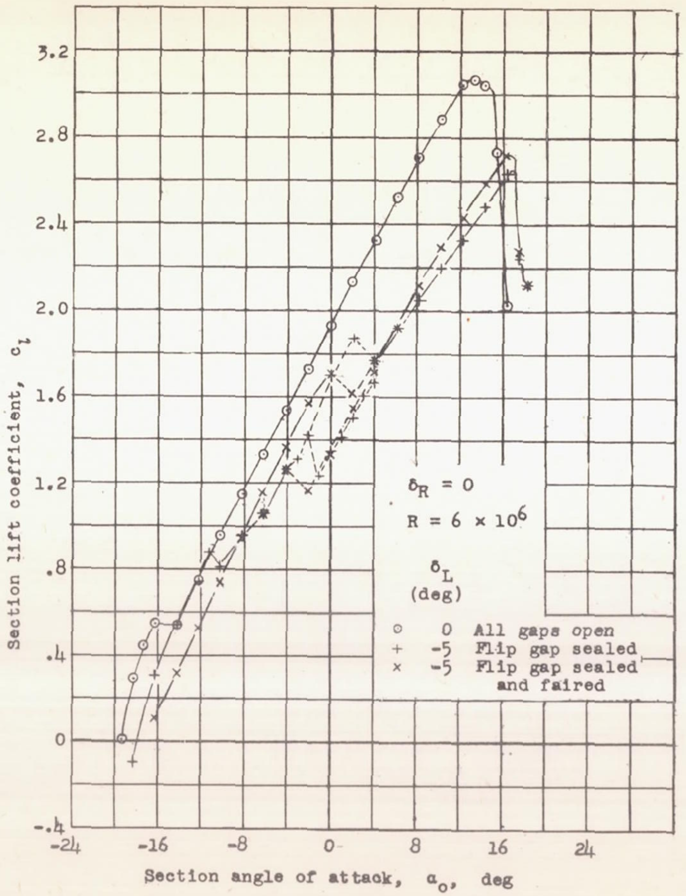

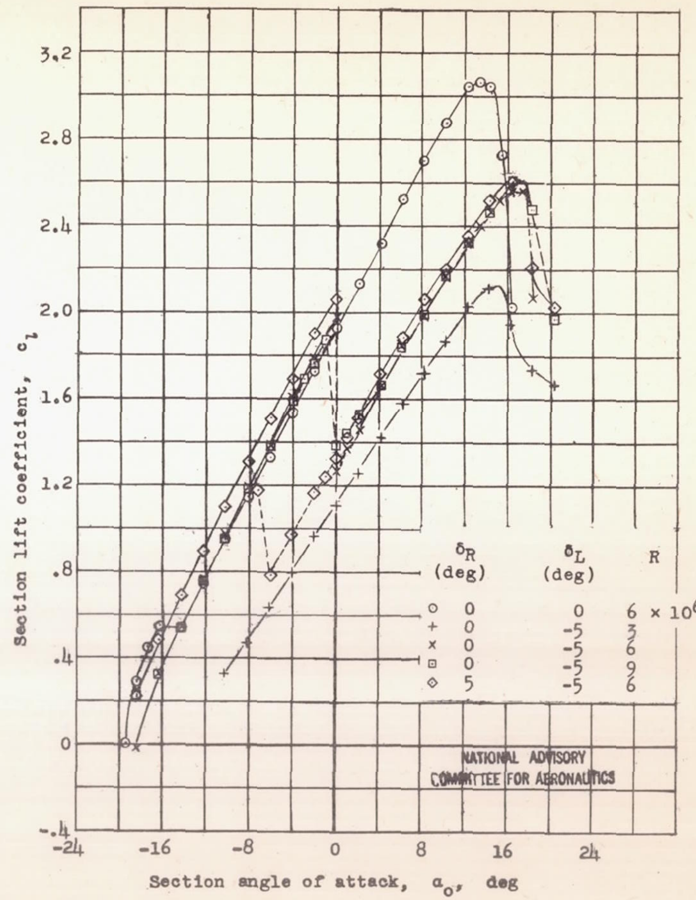

Figure 24.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_f = 50°$. Test, TDT 391.

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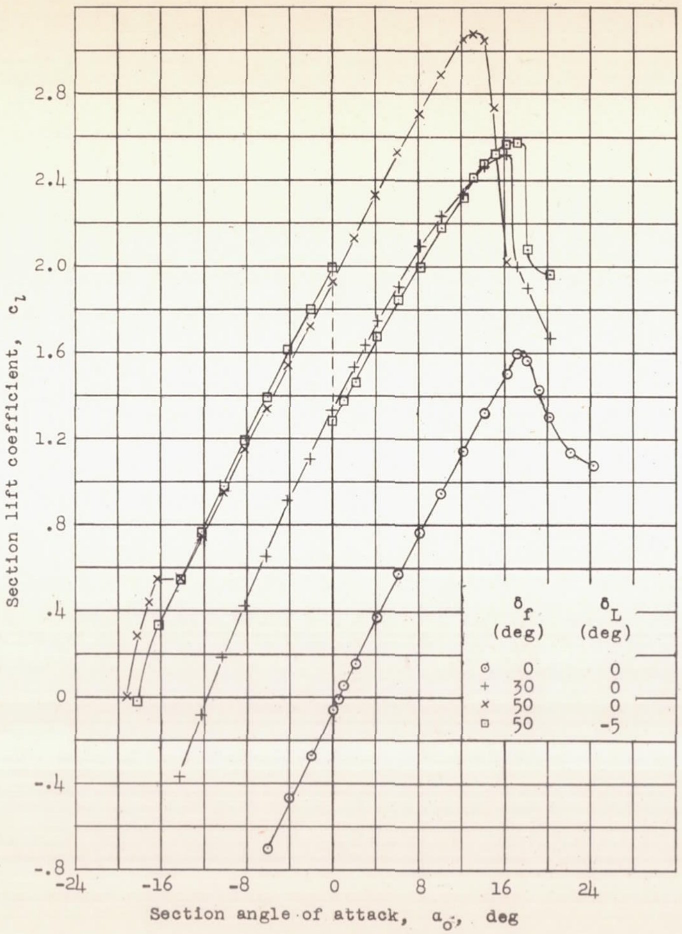
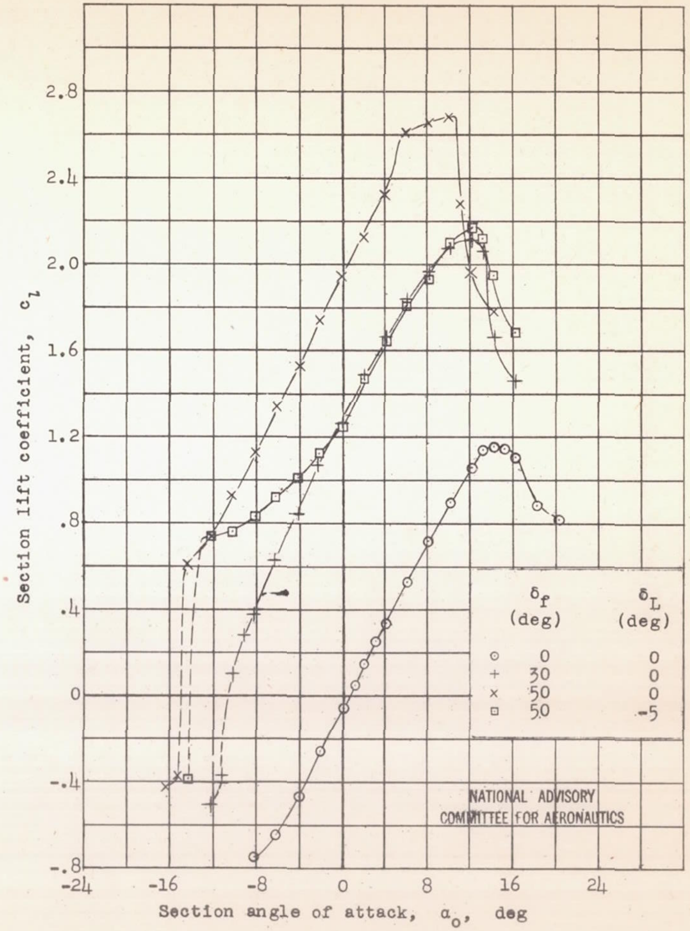


(a) Smooth condition.



(b) Leading edge roughness.

Figure 25.- Lift characteristics of a Douglas airfoil of NACA 7-series type with double-slotted flap, aileron, and flip, station 950 of C-74 wing. $\delta_R = 0^o$; $R = 6 \times 10^6$. Tests, TDT 391 and 393.

MR No. L5C24a